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THE MECHANICAL MANAGEMENT OF THE WORLD'S STOCK OF GOLD.

By Alex. Del Mar.

The larger undertakings in which the engineer is concerned are intimately connected with problems of finance. But above all he is interested in the application of practical economy and common sense in the physical operations of business. Recent events have called attention to a striking opportunity for the exercise of these qualities to prevent the constant, wasteful, and inconvenient transport of actual gold coin or bullion to and fro across the Atlantic, sometimes making voyage after voyage in the same unopened packages, when a far more scientific method of balancing the gold stock should be adequate for all purposes of international commerce and exchange. Mr. Del Mar's interesting proposal has thus the elements of timeliness and of practicability to recommend it to the attention of an engineering and industrial audience.—THE EDITORS.

THE precious metal, whose supply to the world now amounts in value to something over a million dollars per diem, is nevertheless so mechanically managed that it fails to subserve fully the tremendous interests which depend upon it. It is to this purely mechanical problem, and not to any other relation of gold except so far as such relation may flow from the mechanism, that the present article will be devoted.

Gold is used not only for the purposes of money, but also in the arts; and as the very first feature of the problem concerns the quantity to be managed, it becomes necessary at the outset to estimate the relative quantities reserved for money, and used up in the arts; next to consider whereabouts the Stock lies; and finally to offer such a plan for mobilising it, or some material portion of it, as will render it most subservient to the interests of the commercial world.

PROPORTION USED IN THE ARTS.

This subject has engaged the attention of numerous enquirers; the usual method being to address circular letters to the jewelry, dentistry,

gilding, and other trades using up gold, and to make conjectural allowances for such as fail to answer the enquiries fully. This method is so defective that it has never been even approximately successful. To cover the ground completely, it should embrace the entire commercial world; and the replies should be comprehensive and truthful. But no official has authority to compel replies even in his own country, much less in foreign ones; and no manufacturer or consumer of gold in the arts cares to disclose to others the extent of his business operations. Enquiries of this character have therefore always ended in failure. The writer of this article, once an officer of the United States Treasury Department, has had considerable practical experience in the matter; and he is satisfied that no return of the sort ever made, either before or since, is worth the paper it is written upon. Such returns seldom amount to more than 25 per cent of the production; and even when eked out by conjecture, rarely exceed 35 or 40 per cent.

The only reliable method of obtaining such information is, from the entire quantity of the metal reported produced, to deduct the quantity of the discernible Stock on hand. The quotient must show the amount consumed in the arts, plus the quantity lost by attrition or accident, hidden in forgotten hoards, or exported to the uncommercial world. The quantity of gold hoarded is too small to deserve consideration. The results obtained by this method prove that the usual estimates do not embrace more than about one-half of the quantity really consumed in the arts, or otherwise lost to commerce. In other words, the supplies of gold to the visible Stock, after deducting recoinages, seldom exceed 25 per cent of the reported production; and at one period, 1828 to 1838, did not amount to more than 18 per cent. The details, which embrace the entire period, by short intervals, from 1675 to the present time, will be found in the writer's "History of the Precious Metals." These proportions include both gold and silver, because until recent years the Stocks on hand were always reported or estimated in both metals combined. While it is not believed that the proportion of gold consumed in the arts, etc., to the whole amount produced, is quite so great as that of both metals combined, it is nevertheless certain that it is not much below it; a belief founded upon the coinages of new gold and upon the reported Stocks of that metal on hand.

Gold in Sight.

Reverting now to this subject, there is to be discerned today in the various treasuries, banks and other depositaries of the commercial world, a Stock of gold coin and bullion equal in value to about three thousand three hundred million dollars. Without discussing that fur-

ther sum which is estimated to be in circulation outside of the treasuries and banks—usually a matter of conjecture, and always one of dispute—it becomes necessary to set forth where this Stock is deposited, as preliminary to the discussion of how it may best be mechanically managed.

GOLD STOCK OF THE COMMERCIAL WORLD AT LATEST DATES.

	Millions of dollars.
United States Treasury, November 1, 1907	916
Bank of France, November 14	541
State Bank of Russia, November 5	508
Bank of Austro-Hungary, November 7	229
Bank of Italy, October 20	167
Bank of England, November 14	159
Imperial Bank of Germany, November 9	146
Bank of Spain, November 10	78
Bank of the Netherlands, November 9	38
Bank of Naples, October 10	35
Bank of Scotland, September 21	26
National Bank of Denmark, October 31	24
National Bank of Belgium, November 7	21
Royal Bank of Sweden, September 30	21
National Bank of Roumania, November 2	20
Bank of Ireland, September 26	16
Switzerland, banks of issue	13
National Bank of Switzerland, November 7	12
Germany, local banks, October 31	11
Bank of Sicily, October 10	9½
Bank of Norway, September 30	9
National Bank of Bulgaria, October 13	6
Bank of Portugal, October 16	5½
Bank of Finland, October 15	5½
National Bank of Servia, September 30	3
National Bank of Greece, September 30	0½
	3,020
Add for omitted banks and depositaries in the United States and for depositaries in Canada, Mexico, Central and South America, the European and American Colonies, Turkey, Egypt, India, Japan, and the commercial ports of China, say,	280
Grand total of Gold in treasuries and banks	3,300

Of the 916 millions of Gold Stock reported by the United States Treasury, 749 millions were "Trust Funds"; in other words, they were held against an equal sum of gold certificates at issue. These certificates and the Clearing House certificates largely figure in the bank accounts as "gold." On the one hand, they are as good as gold, because gold can be obtained for them on demand. On the other hand, to add them to the gold in the Treasury would be to count the same metal twice over. From this Table it appears that the United States Treasury holds nearly 30 per cent of all the gold in treasuries and banks throughout the commercial world. The United States Treasury is therefore in an excellent position to undertake any reform in the

"Mechanical Management of the Gold Stock" that may promise to render it more effective. Taken in connection with the enormous crops and mineral and manufacturing production of the country, it also affords a guarantee of financial strength that can scarcely fail to attract universal attention.

It is a popular delusion that the present method of managing this Stock leaves it substantially free to flow whither it may be demanded in exchange; but in fact it is attached, by means of numerous and often hidden ligatures and restrictions, to the country which has succeeded in securing its possession. For example, in Great Britain, the coinage of gold, or the conversion of gold bullion, which is *not* legal tender, into gold coins which *are* legal tender, is nominally free, but really restricted. The Mint will not receive for coinage less than £10,000 worth (about $50,000) in any one deposit. This rule practically throws the entire Mint purchases of gold into the Bank of England, which, although obliged to receive it at a fixed price, is nevertheless at liberty to send it first to its own refiners and assayers, with the result that the depositor is subjected both to expense and delay; conditions that, apart from a legally unrestricted Bank rate of interest, seriously hamper the free movement of the metal, either for coinage or export. In France, Germany, Austria, Russia, etc., there are other but somewhat similar restrictions. In all these countries, as well as in the United States, the laws require a certain amount of gold to be held as reserves against Government or bank issues, or for other purposes. Some of the countries named retain large sums of gold as a War Chest. Without going into details, which a lack of space forbids, the general result is that so far from being free to respond to the demands of trade, the world's available Stock of Gold is so tied up, that a demand from one country to another, even in exchange for securities or commodities offered at a depreciation of 25 to 30 per cent, is responded to with the greatest reluctance, difficulty, and delay. Recent events have shown what great efforts and sacrifices were required to draw from Europe to the United States an amount of this metal equivalent to less than a single year's production of the mines of the latter country alone. It is quite warrantable to estimate that no conceivable circumstances would suffice to invite across the ocean so much as a single year's production of all the mines of the world—the fact being that gold enters into the arts and the coinages of the commercial world almost as soon as it is produced; and that once thus engaged, it is, as the case stands, almost impracticable to withdraw it in any large amounts from the countries of consumption or employment.

There are some minor, though not unimportant, obstacles to the mobility of the Gold Stock. The expenses of shipment, including freight, insurance, interest and recoinage, are by no means negligible obstacles. The recent depreciation in cotton and wheat bills reflects only a portion of these obstacles; they are also reflected in the fall of shares and other securities.

Remedy Proposed.

It is believed that there is no insuperable difficulty in the way of remedying this immobility of the Gold Stock and of rendering it amenable to the demands of legitimate commerce. That there *are* difficulties must be freely admitted. As the case stands, each great commercial State requires, and must have, command of the means to liquidate its paper issues in gold; but there is no essential reason why the whole Stock of gold should not be rendered more readily amenable to such sacrifices as commerce and credit are able or willing to concede in the interest of restoring their own equilibrium. The honor and resources of each State are pledged to the payment of its obligations, and they will therefore have to be paid. But there is no necessity for each State selfishly to accumulate gold, and to render it difficult for its neighbors to obtain it when required by the exigencies of legitimate commerce—and to obtain it, too, without being obliged to sell securities and products at bankruptcy prices.

The remedy proposed is purely mechanical. It is to mobilize the entire Stock of gold held by the contracting States, by means of issuing, against such Stock, certificates of deposit, which shall be made legal-tenders in all of the contracting States, except at the Treasury of the State of issue. Each State shall substitute such certificates in place of the gold, for all purposes for which the gold itself is now employed; and shall undertake to pay them on demand. The security afforded by such certificates would be just as good as—nay, even better than—that of the gold itself. The expense entailed and time lost in conveying the metal to and fro across the ocean and of recoining it, would be avoided; and in case of urgent demand from either side, or as between the first-class powers (the only ones which need at yet to be considered in this connection) the certificates would respond to the demands of commerce and of exchange, with a celerity and certainty that cannot be imparted to the metal itself.

Sovereign States have frequently admitted into their monetary circulation, with full legal-tender power, the coins of other States. Therefore there can be no objection in principle to their admitting the

coin certificates of deposit herein proposed. The chief coins of Spain were formerly full legal tenders in the United States; those of Portugal were legal tenders in England, and those of England are today full legal tenders in Portugal and several other States. A Convention, commonly known as the Latin Monetary Union, dated December 23, 1865, taking effect August 1, 1866, was entered into between France, Belgium, Switzerland and Italy, which provided for a uniform system of coinage based upon the franc and for the admission to full legal-tender privileges in all of the contracting States of all the gold and certain of the silver coins of each State. In 1867 this Convention was joined by the States of the Church and by Greece and Roumania. On September 20, 1872, a similar Convention, commonly known as the Scandinavian Union, was made between Denmark, Sweden, and Norway, providing for a uniform system of coinage based upon the kroner and for the admission to full legal-tender privileges in all of the contracting States of all the gold and certain of the silver coins of each State. These provisions were adopted in the Danish, Swedish, and Norwegian laws of May 23, 1873, May 30, 1873, and June 4, 1873, and by the Treaties of May 27, 1873, and October 16, 1875, which went into effect April 1, 1876, and were rendered obligatory from January 1, 1877. Many other instances of this kind are mentioned in the writer's "History of Monetary Systems," and "The Science of Money." Already we have an International Postal Union and Money Order system which deals in credits amounting to hundreds of millions per annum. During the present year, alone, the United States Post Office Department reports having transmitted over 72 million dollars (equivalent to gold) to other countries, in the form of drafts or bills of exchange drawn upon foreign postal departments. This is a sum substantially equal to the whole amount of gold imported during the late financial flurry. Why not, then, a system of International legal-tender certificates, backed by deposits of gold coin to the full amount of their issue, but, unlike the coin, full legal-tenders in each and all of the contracting States? When wanted at home, as a basis for other issues, they could be locked up in the Treasury; when wanted abroad they could be used at once without expense of carriage or of recoinage.

Whatever objections to this plan may arise from considerations connected with the guaranteed domestic issues of each State are at once disposed of by the reply that the same objections are equally valid in respect to the coins or bullion now held against such issues. There are, in fact, only three difficulties in the way. One is, where

shall the Stock be deposited? Virtually a mechanical consideration; for it is not to be supposed that the United States, Great Britain, France, Germany, Austro-Hungary, Italy, or Russia could find reason to distrust one another for the sake of a sum of gold that would not equal a tithe of the current contracts which would be voided by a declaration of war.

The second objection is the political one of observing such a contract in case of hostilities. But as the payment of national obligations, the rights of neutrals, and many other equally important matters, are now by convention preserved from the consequences of war, there can be no great difficulty in arranging this one. Besides, as the full legal-tender quality of the proposed certificates would depend not merely upon the disposition of any two States which might go to war, but upon the Treaty obligations and rights of all the contracting States, there need be no fear that the Convention would not be scrupulously observed by all of the signatory powers. The third objection is that of denominations. This has been already solved by a scale which enables large sums in pounds-sterling, francs, marks, florins, roubles and dollars, to be expressed in national integers of equivalent gold weights.

The only single unanswered difficulty is: Where shall the Stock be deposited? The solution of this problem lies on the surface. Let each State keep its own Stock; let it be agreed by Treaty that each State shall only be at liberty to issue International Certificates of Deposit equal to its own reserved Stock of gold coins held in the public Treasury; and let the Certificates be valid only when countersigned and registered by the Commissioners of all the contracting States.

There need be no difficulty in providing an adequate penalty for the infraction of so solemn and important a convention. The plan herein outlined would virtually provide a Bank of the World; and its promise of influence in securing the peace of that world should be great enough to sweep away any objections to its adoption that may be raised by either class interest, or diplomatic intrigue.

Details of Management.

Assuming that the public advantages of this plan may commend it to the favorable consideration of Government, certain details of management may be connected with it that would still further enlarge its scope, augment its usefulness, and procure for it the support of those numerous interests, without whose co-operation it is often difficult to secure attention for mechanisms which, like the present one, are proposed for the public welfare.

Selecting for illustration only one of the details alluded to, it is to be remarked that the present system of remitting small sums of money to places within the country are cumbrous, expensive, and unsafe. It is a choice, on the one hand, of a postal order, which in thousands of towns and villages cannot be obtained at all, and which, where attainable, costs far too much, both in time lost and in traveling expenses and fees; or, on the other hand, of a remittance by letter of coins or notes and postage stamps; always an unsafe procedure.

The aggregate of money orders required in the near future within the United States is estimated by the Post Office officials at about 400 or 500 million dollars per annum. The amount likely to be remitted in money and stamps is probably as great. It is believed that with additional facilities the money orders would readily increase to 1,000 millions, with a corresponding increase in trade, which trade is now wholly neglected for the lack of remitting conveniences. The remittances of money and stamps would of course decrease, but not nearly to the extent that the money orders would increase. A somewhat similar remark is applicable to the small remittances between this and foreign countries. It has been estimated that were foreigners in South America and the Orient provided with a convenient method or mechanism for remitting money to the United States, especially from interior towns, it would result in doubling the export trade of manufactured goods and machinery to those countries.

To provide this mechanism, and without any other expense than paper and printing, all that is necessary is to print, say, 50 million dollars of the proposed Certificates of Deposit in small sums, leaving a blank space on each certificate, after the "Promise to pay (so many) dollars," in which space the name and address of a payee may be written by the remitter. This would at once convert the Certificate into a Bill of Exchange, *e. g.*, on the United States Treasury. When made thus available in distant countries such Certificates would be eagerly sought after and command an extensive circulation abroad, with a corresponding accession of gold at home. After payment at the Treasury, the Certificates could be destroyed and re-issued in blank (or to Bearer,) as before. They should be engraved in several languages, side by side.

When it is recalled that nearly 300,000 letters containing money or postage stamps are annually handled in the Dead Letter Office, for lack of proper addresses or for other reasons, it will be perceived how much benefit to the public from employed remittances, and profit to the Government from unclaimed remittances, would follow such a reform in the Management of the Gold Stock.

THE MANAGEMENT OF PRODUCTION IN A GREAT FACTORY.

By George F. Stratton.

DIVISION OF RESPONSIBILITY AND AUTHORITY IN THE GENERAL ELECTRIC COMPANY'S SHOPS.

Mr. Stratton's article is the first of a small but significant group to appear in THE ENGINEERING MAGAZINE, giving a graphic idea of the production methods of a few of the leading manufacturing plants in the United States. The establishments selected will all be of world-wide reputation and interest on account of technical and commercial success. The descriptions will be by men intimately familiar with the internal life and movement of the shops. They will not attempt to go so far into detail that the large perspective is lost, but they will concentrate the organic essentials into a clear, easily grasped picture of the whole. They will show how, in these vast works, an army of men is kept in orderly and productive employment on a multitude of operations, all moving harmoniously to the completion of the desired product. The next paper expected in the series will describe the manufacturing system of the Westinghouse Electric & Manufacturing Company.—THE EDITORS.

IN the great manufacturing plant at Lynn, Mass., where more than ten-thousand hands are employed, visitors who satisfy the manager that they are something more than curious sight-seers are readily admitted and furnished with guides. These visitors may be officials of other great plants—engineers, managers, or superintendents—or they may be proprietors or employees of very modest shops, working perhaps on specialties. But whoever they are, the questions which they put to the guides with the greatest frequency and interest relate to the management. What impresses a man first, and with apparently the greatest force, is the control of so large a force of workers, and the movement of great quantities of material and parts in such rhythmical order and succession as to keep every man at work and working smoothly.

One of the guides, a young and exceedingly bright engineer, has a set formula for reply to questions on this subject. "The manager," he will say, "is at the top. He takes all the kicks and all the credit. The engineering department designs all the work—tells the men what to make; the superintendent of production tells them how much, or how many to make; and the mechanical superintendent tells them how to make it, and sees that they do it."

This is concise. Its conciseness needs no qualifying adjective. Visitors who are themselves engaged in large affairs recognize this and often, with twinkling eyes, appreciate the futility of seeking detailed information during the necessarily hurried tour through the thirty or forty shops comprising the plant. Smaller men are awed by it. They recognize its sweeping comprehensiveness and are undoubtedly hungry for details, but, fortunately for the guide, searching questions are not easy to formulate and the trip usually ends unsatisfactorily to them, as far as concerns insight into the management.

"I would far rather," said one such man to me, as we were watching the dense crowd of workers pouring into the streets at the noon hour, "I would far rather know how these men are handled without confusion, how work is furnished for each one of them without waste of time, and how the stuff is pushed through the various shops, than listen to the most exhaustive description of the plant and the product."

As a matter of fact very many of the employees, even above the grade of workman, do not understand the plan of management. They know to whom to look for orders, or rules on discipline, in their own particular line of work, but beyond that they have little opportunity to acquaint themselves. Moot questions are referred to other departments, and again to others, in apparently a hopelessly confusing manner. Yet there is really no confusion, and seldom anything but a ready and prompt determination of the responsibility—or non-responsibility—(the lines of which are sharply drawn)—of each department.

It is hardly within the scope of this article to do more than briefly mention the administrative department; the board of directors (elected directly by the stockholders and immediately responsible to them for the entire conduct of the business) and the president (appointed by the directors), who usually attends to the finances of the company and frequently dominates its financial policy.

The story of the interesting details of factory management really begins with the vice-president, and although systems vary in different plants, that of the company already alluded to may be taken as a type.

There are two vice-presidents. The first is the head of the commercial system, which comprises the distribution of the manufactured products, the establishment and conduct of sales agencies, and all consequent operations. He is also in control of the engineering department—auxiliary to which and subordinate to it is the draughting force. The engineers design the machines and apparatus to be manufactured. They are responsible for the efficiency of such products and, when required under contract, for the proper installation and

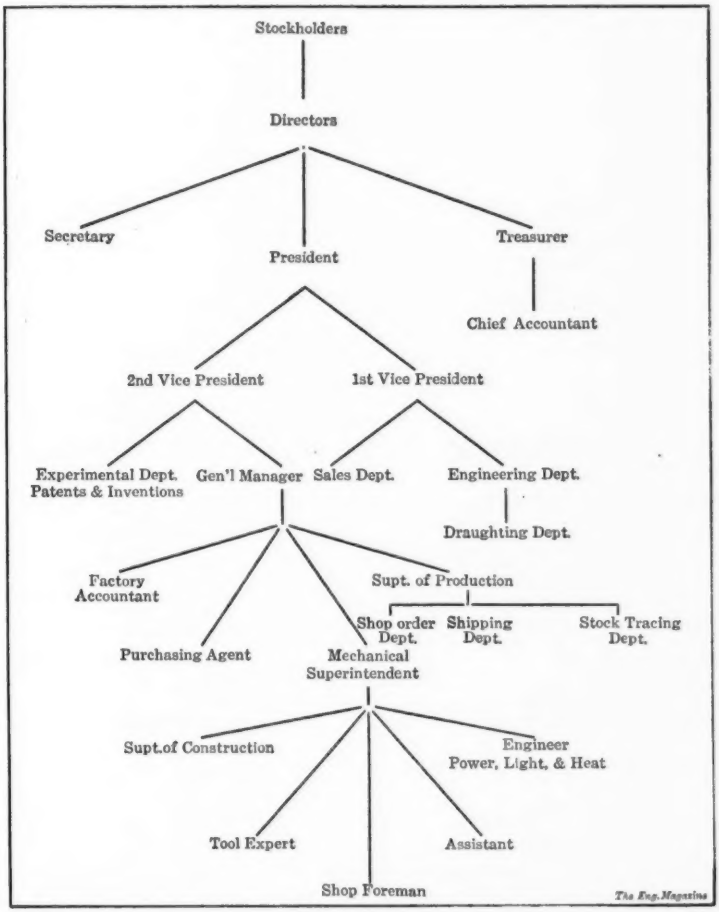


DIAGRAM OF MANUFACTURING ORGANIZATION, GENERAL ELECTRIC COMPANY'S LYNN SHOPS.

testing of special apparatus. Theirs is purely the scientific end of the business. They have nothing to do with the manufacture except to watch closely, as they do, to see that their drawings and instructions are rigidly followed, and that no materials other than those they specify are used. They have no concern in the sales, or the profit and loss. Their concern is entirely with the reputation of the goods; upon which, of course, rest their own personal reputations.

The second vice-president is at the head of the production department—a general charge involving the plant, its equipment, and the entire line of manufacture. Briefly, he makes the goods;—the first vice-president sells them. The second is also in control of the experimental department which covers all mechanical tests and investigations, and the securing of inventions and patents.

The real executive head of the factory proper is the general manager. Although, in many manufacturing plants this official is also in charge of the sales department, in the system we are describing the manager has nothing whatever to do with the commercial end. His responsibility commences with the receipt of orders from the commercial department and ends when those orders are shipped out. That sounds simple, but it involves much. The buildings and equipment must be designed and arranged with the closest study of economy in handling men and materials; the supplies must be purchased with the keenest of foresight and acumen; the working force must be handled with discriminating firmness; the wage schedules must be scrutinized continually and minutely, and every item of shop expense viewed with suspicion and religiously compared with preceding percentages. The manager is responsible in a great measure for manufacturing at prices which will ensure successful competition with other shops. Upon him largely depend the figures on the profit and loss account.

Right at this point it might be well to dwell for a moment upon the irrepressible friction which seems to occur in many large engineering establishments between the engineers and the manager or superintendent. I use the phrase "seems to occur" advisedly. There is rarely any real friction. What seems to be such is simply the arguing by the two departments, from different points of view. As previously stated, the engineers are concerned solely with the efficiency and reputation of the machines built; the manager is concerned chiefly with the cost, and the ever-looming spectre of loss instead of profit. The one department is a healthy check upon the other; a check upon what might develop, on the one hand, into an inordinate extravagance of detail and expensive finish; on the other hand into a disastrous cheese-paring economy, with its concomitants of poor workmanship and inferior material.

Immediately under the general manager are the mechanical superintendent, the purchasing agent, the superintendent of production, and the factory accountant.

The mechanical superintendent has charge of the shops and machinery, and the discipline of the men. He has four assistants: A

tool expert, who designs special machines and tools needed in the equipment and who continually watches new machine tools which come on the market, reporting upon their capacities and efficiencies; a superintendent of construction, who builds and repairs the shops. This man has a standing force of nearly one hundred carpenters, masons and plumbers—and at times when a new shop is being erected his force is largely increased; the third assistant is the engineer of power, heat, and lighting. His duties comprise the care of the steam and electric power generators; the over-seeing of the steam engineers, the firemen, and the electricians; and the proper arrangement of steam pipes and lighting wires, etc.; the last assistant sees to the discipline of the hands; the proper working of the time-recording systems; the inquiry into absentees; the engagement of new hands; the orderliness and cleanliness of the shops, and the general sanitary arrangements.

The mechanical superintendent has nothing to do with fixing any wages; they are always determined by the various foremen, after consultation with the general manager. His duties and responsibilities are comprised in the purchase or building of proper equipment, the hiring of proper men, and the direction of those men in carrying out the orders of customers received through the superintendent of production.

The purchasing agent purchases everything required in factory or office—from a lead pencil to ten-thousand tons of coal or pig iron. He has a force of assistants and a system of records by which comparisons with past prices are readily made. He is under the immediate control of the general manager.

The superintendent of production* is also in the general manager's department. He receives shipping or manufacturing orders from the commercial department and distributes shop orders to the various foremen, and to the head shipper. A very important duty of his department is that of keeping track of the stock of finished products ready for shipment, and of such products in course of construction, so as to enable the manager to determine readily the condition of affairs all through the factories, and the possibility of immediate or early shipments when required. It is to this department that the shop foremen come for orders to keep their men going; and upon its intel-

* The term "superintendent of production" suggests a range of authority which hardly exists. Although the entire productive energy of the plant is engaged upon orders issued by him alone, and although his proper distribution of these orders is depended upon to keep every department working smoothly and harmoniously, he has no authority to enforce them. That rests with the mechanical superintendent. In effect, he works in co-operation with this officer, both being subject to the manager but not either one to the other.

ligent distribution of orders largely depends the steady and frictionless flow of work through the numerous shops. No department chief could so quickly and effectually bring disorder and confusion upon the entire plant as the superintendent of production.

The shop-accounting department, also under the general manager, is in three sections. One keeps account of the purchases of supplies, of shop expenses, direct and indirect, of costs of construction and equipment, and of shipments. Another, called the cost division, keeps an elaborately systematized record of the cost of manufacturing. The third section is the paymaster's—where day and piece work is figured and the pay-rolls are made up.

Then, a little lower in the scale, come the foremen; several of whom are in charge of five or six hundred hands each, with perhaps ten or a dozen assistant foremen under them.

Such, briefly, are the personnel and duties of the various departments of this plant. If the passage of an order through the various shops is followed, it will clearly show the inter-relation of one department with another.

Assuming that a contract has been obtained for, say, a special, high-powered, turbo-generator, and that the engineers have prepared drawings of all details; an order comes from the commercial department to the superintendent of production. It is numbered, and directs him to build a machine according to specifications carrying the same number. From that moment, with every detail of that intricate machine, with every cent's worth of material used in it, with every stroke of labor expended upon it—that same number is used. When that engine is finished, the shop records, properly tabulated, show to a fraction the cost of designing and draughting, of labor, and of material put into it.

The superintendent of production at once issues shop orders (all similarly numbered). Some go to the pattern shop for such parts as will be required, others to the steel, iron, and brass foundries, others again to the machine shops. The work may be commenced in a dozen different shops simultaneously, and in all probability the mechanics engaged on such work will never see the engine assembled —or any part of it, excepting that which they themselves have finished up. In the meantime, the mechanical superintendent has been in consultation with his assistant—the tool expert. It may be that, for this special engine, some new tool or tools will be required. That matter is settled. It is also possible that additional shop room may be required—a setting-up floor, or some change in one of the buildings.

The superintendent of construction is called upon, his mill draughtsmen set to work and the necessary addition, or change, at once put under way. With the shop orders sent out to the foremen are blueprints of the detail drawings of all the parts. As soon as they are received the foremen are required to notify the superintendent, at once, of any materials or small tools which will be needed. If satisfied that their requirements are correct, he in turn puts in a requisition to the purchasing agent, who takes proper steps to supply the wants.

When the castings commence to come from the foundries, and are distributed among the various machine and finishing shops, the engineers are constantly on guard. They are as solicitous as any parent can be in the training of his child. Many are the little disputes with foremen, which have to be referred to the superintendent, and perhaps to the manager. There are blueprints everywhere, frequently thumbed and worn so much that a half-dozen successive copies may be called for by some foremen.

In due time the parts come—it may be from eight or ten different shops—into the assembling room, and the engine is set up. Steam pipes are connected and, with the engineers in charge, exhaustive tests are made. When all is satisfactory it is taken down and shipped, and a small force of men under an expert foreman follow it to its destination, where they install it permanently. A final test is then made by the company's engineers and the representatives of the customer.

In the meantime, the cost department has been collecting the details of the cost. That of the labor is obtained from the paymaster; that of the material, from the purchasing agent and from the various stock rooms of the shops where the work has been done. The system used is complete and reliable, the result showing the actual factory cost of the engine, but not including the factory expense, which is figured under a logically determined percentage ratio by the accounting department.

In addition to these regularly constituted authorities there are various committees for various purposes. In this company's manufacturing operations there are two standing committees, to whom matters too momentous—or of too general consequence to the entire plant to be decided by any one department chief—are referred.

One is the manufacturing committee, before which questions of the desirability of taking up new lines of manufacture or discontinuing old ones, are decided. It is formed by strong representatives from

the sales department and from the engineering department, with the mechanical superintendent and the superintendent of production. Frequently shop foremen are called into its meetings for detail information.

The other committee is known as the shop plant committee. It decides upon questions of radical changes in the arrangement of existing shops, and the location and equipment of new ones. Its members are the general manager, the mechanical superintendent and his assistants, and the principal shop foremen.

In addition to the irregular and perhaps infrequent meetings of these standing committees, special meetings are frequently called by the general manager to discuss questions of shop policy. The members may be of the office force, or, more frequently, a few of the foremen directly interested, and occasionally of the workmen—selected, perhaps, for their skill on special lines or, which is more likely, for their judgment of and influence with their fellow workmen.

As has been already intimated, there is but scant knowledge of the completeness of this systematic organization, even among many of the office employees; still less among the workmen. This is unfortunate, and is the direct cause for the inveterate growling about "red tape" so prevalent among workmen in highly organized plants. If these men could understand that the trifling entries they are compelled to make upon time cards and piece-work slips are of the first importance—if they could see that, when a man changes from one job to another, there is a vital reason for a record of that change—if they could understand the lines upon which each chief of department is working, and the motives which actuate when apparent conflicts occur—their interest in the whole plant, and in their individual work, would hardly fail to increase largely.

If they knew that the trifling data recorded by themselves each day, at an expenditure of perhaps five minutes of time and often a woeful expenditure of profanity, were the means, and often the only means, of enabling the officials to determine accurately costs of production, and hence to secure the confident ability to figure on future close contracts—those men would see that the prosperity of the company, and the continuance of steady work for themselves, must depend upon "red tape"; or, distinctly stated, upon a system of high organization which can have its root and its fruit only in a strict adherence to clearly outlined divisions of responsibility and authority, and in accurate recording of the minutest details.

PULVERIZED COAL AND ITS INDUSTRIAL APPLICATIONS.

By William D. Ennis.

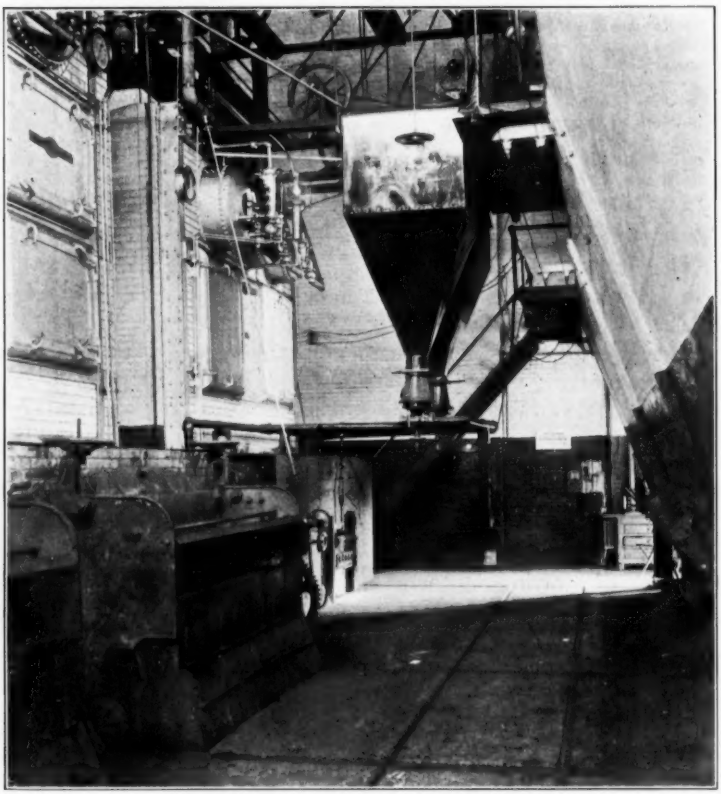
II. MODES OF FIRING AND CONSTRUCTION OF THE FURNACE.

In this installment Professor Ennis concludes his review, begun last month, of the industrial applications of pulverized coal. The preceding article discussed the characteristics and preparation of the coal, illustrating and describing the leading types of drying, grinding and conveying devices applicable to its economic use as a boiler fuel. In the following pages Professor Ennis describes methods and apparatus for firing, and gives details of the cost of installation and operation. In conclusion he points out that the commercial value of pulverized coal is not limited to its use in the boiler furnace but that it is destined to have a wide-spread application in the metallurgical industries, where its cheapness will enable it to replace oil and gas for the firing of certain classes of industrial furnaces with no loss of convenience or rapidity of operation.—THE EDITORS.

THE device for feeding pulverized coal into the furnace is a matter of importance. To some extent, this importance has been over-emphasized, in discussions of storage-bin stirrers, swing sifters, air preheating, etc. The essential features of a good feeder are: positive action, ensuring an uninterrupted supply of fuel to the furnace; provision for a sufficient length of flame before striking cold surfaces; the holding of the dust in suspension until each particle has been consumed; intimate mixture of the dust with air, and definite provision against the flushing down of large quantities of dust at a time. The last requirement prohibits all forms of purely gravity feeding. The necessity for suspension of the particles, producing what is practically gaseous combustion, leads to the usual practice of spraying the fuel into the furnace, either mechanically or by means of air pressure. Mechanical feeders are used in connection with natural draft, usually without any attempt at automatic regulation of the air supply. Air-blast feeders give forced draft, and lend themselves readily to air regulation. With an air blast against a refractory bridge wall or arch (sometimes of firebrick faced with carborundum), high efficiencies may be obtained, but the blow-pipe action of the flame is highly destructive.

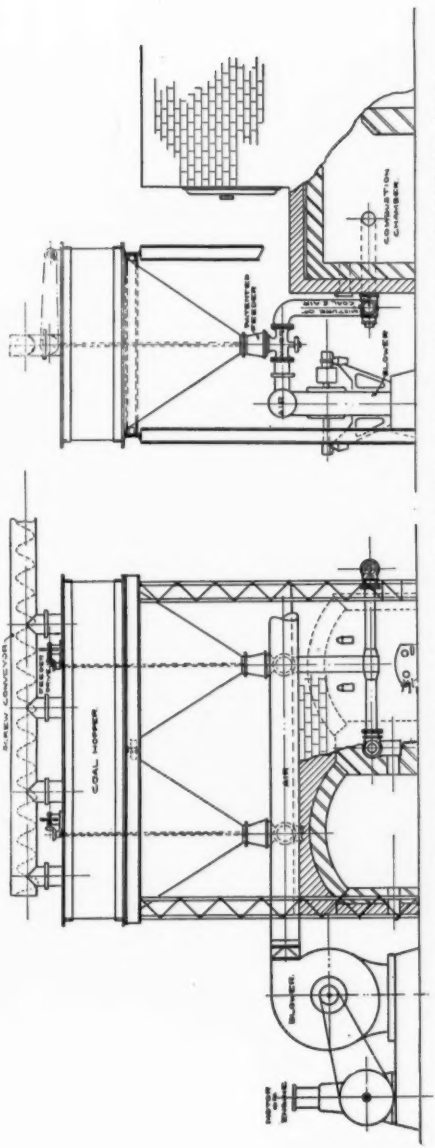
An early suggestion for the use of pulverized coal was to provide a small independent pulverizer directly in front of each boiler, grinding as needed and discharging directly to the furnace. This eliminated

storage and conveying problems, but did not meet the requirements as to drying, concentration of plant, and saving in labor. A later suggestion was to retain the central pulverizing plant, using an air injector for feeding. The principal objections to this method of feeding arose from defective regulation, the high air pressure required, and the necessity for augmentation of the blast air by natural draft. Probably the simplest satisfactory feeding arrangement introduced was that of providing short screw conveyors, which received the coal through down spouts from the overhead bins and delivered it to blast pipes leading into the furnace. These prevented "flushing down,"



APPARATUS FOR BURNING POWDERED COAL INSTALLED IN THE POWER PLANT OF THE EDISON ILLUMINATING CO., DETROIT, MICH.

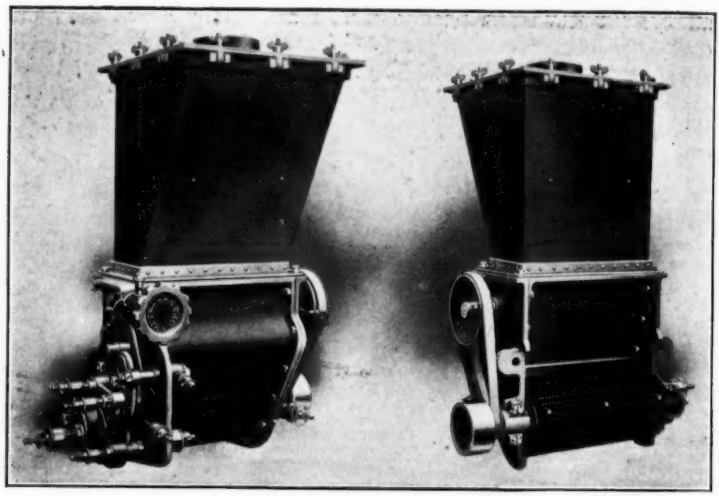
A 365 horse-power Babcock & Wilcox boiler equipped with the system of the International Combustion Corporation, Buffalo, N. Y.



TYPICAL INSTALLATION FOR PULVERIZED COAL BURNING, INTERNATIONAL COMBUSTION CORPORATION, BUFFALO, N. Y.

and in cement kilns gave a well-distributed flame. The International Combustion Company's feeder takes the fuel from similar down-spouts and delivers it in controllable quantities to an air-blast pipe. The admission of fuel and air is simultaneously controlled by variations in the steam pressure, by means of an apparatus similar to a damper regulator. An air pressure of from 3 to 5 ounces is used, and while the air thus supplied through a 3-inch pipe to a 125 horse-power boiler is insufficient for complete combustion, the possibility of regulation to the extent of the capacity of a pipe of this size, with supplementary unregulated air supply through the ash pit, permits of fairly economical results. One man can attend to an entire battery of boilers, together with the fan for the air blast.

A modified form of the screw-conveyor method of feeding is covered by the



SCHWARTZKOPFF COAL-DUST BURNER OR STOKER. FRONT AND BACK VIEWS.
Schwartzkopff Coal-Dust Firing Syndicate.

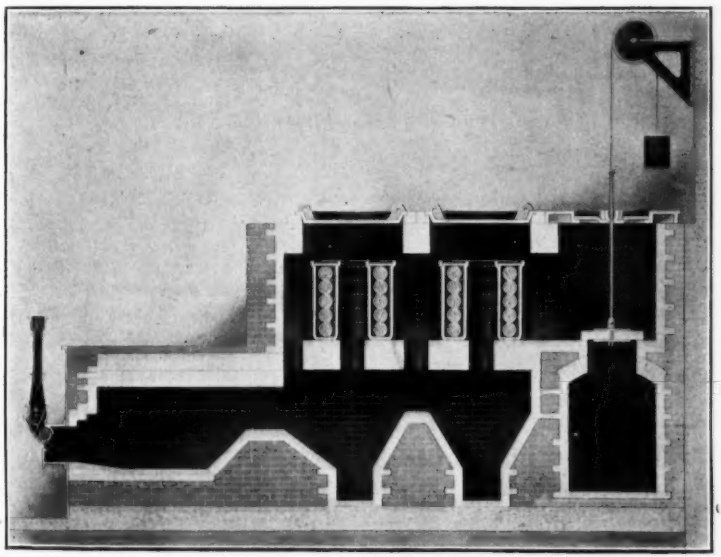
U. S. Letters Patent No. 784,307, issued to J. V. Culliney, involving a self-contained feeding box having one forward conveyor carrying the coal to the air-blast inlet, and one return conveyor which carries back any dust which may have escaped the action of the blast. This feeder is used by the American Iron & Steel Manufacturing Co. at Lebanon, Penna.

For large applications, the individual-pulverizer method is sometimes still retained, as in the case of the Aero Pulverizer Company's apparatus, consisting of a three-stage pulverizer and fan, direct-connected to a motor, receiving the coal in nut size and blowing the powder direct into the furnace or kiln.

Among mechanical feeders, the Schwartzkopff is probably best known. This, illustrated above, consists of a brush which practically sweeps the dust into the furnace. The brush is composed of a steel spindle double-encased with cast-iron sleeves carrying triple flat bristles. It runs in phosphor-bronze bushings, and is rotated by a belt drive at about 850 revolutions per minute. From the brush spindle a reduction drive is taken on each side of the apparatus. On the driven or pulley side, a leather link V belt gives rotary motion to a five-pronged agitator spindle in the upper portion of the feeder, and upon the opposite side a pair of gear wheels actuates an eccentric pulley which imparts reciprocating motion through an adjustable rod

to a rocking lever. By means of a regulating handle and gear of the worm and sector type, a block is caused to slide up and down this rocking lever in such a manner that it may either, by remaining central with the fulcrum, receive no reciprocating motion, or by moving in a downward direction, may receive the maximum motion permitted by the gear relations. The sliding block is attached by a link and pins to the lever on the spindle of a so-called vibratory plate, which forms a movable shutter within the cast-iron sections of the feeder. This mechanically operated plate, upon which the dust fuel rests, closes against the front plate of the feeder when at rest, or when the end of travel of the rocking lever is reached. By the revolution of the brush and the geared drive, this vibratory plate may open and close about 550 times per minute, the amount of such opening being controlled by setting the sliding block in the required position on the rocking lever. The rate of feeding of the coal is of course proportional to the amount of opening.

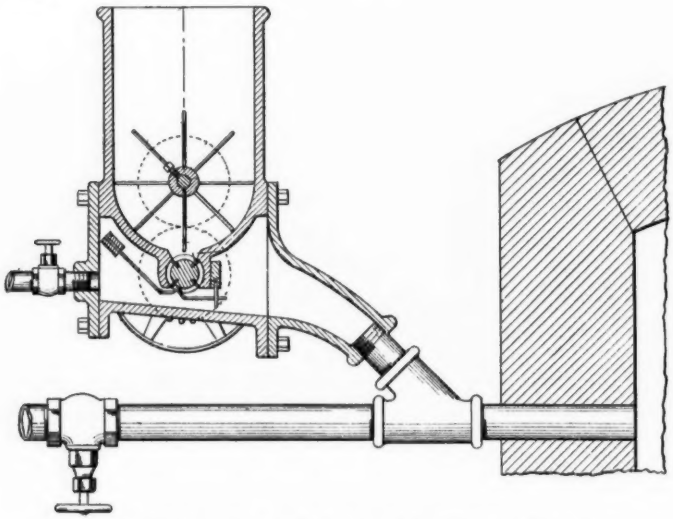
The Welles feeder, shown on the next page, consists of a hopper having a semi-cylindrical bottom in which is cut a longitudinal slot. The pulverized coal is continually stirred or agitated to prevent pack-



ANNEALING FURNACE BURNING POWDERED FUEL.

Schwartzkopff Coal-Dust Firing Syndicate.

ing, and drops as required into the pockets of a revolving shaft below the slot. The quantity delivered to these pockets is determined by the position of an adjustable sleeve. As the pocket shaft revolves, the coal is discharged into the feeding chamber and thence into the furnace. Air for feeding is admitted through the valve into the feeding chamber, and low-pressure air for combustion enters through the end of the Y fitting on the discharge pipe below the feeding chamber.



FEEDING MECHANISM OF THE WELLES FUEL-SAVING SYSTEM.

Actual practice with powdered coal under steam boilers has been limited. It has proven a great labor saver. The labor required for the operations of crushing and drying is not great. At one plant, two men take care of 5 tons per hour. At another small plant, running on a 10-hour basis, the change to powdered coal saved 21 cents per ton in fire-room labor. The cost of fire-room labor in the power houses of manufacturing plants runs from 25 to 75 cents per ton, with an average of not much under 50 cents excepting in large plants running 24 hours daily. Powdered coal should certainly save the larger part of this labor expense.

Coal-dust firing leads to efficient combustion and consequently to high furnace temperatures. The back walls of the settings will be white-hot continuously, and in horizontal tubular boilers, trouble may

be experienced with the back tube ends. In one works it was found necessary to protect these with malleable iron thimbles, as well as to discard fusible plugs, which melted out hollow, leaving only a thin wall immediately in contact with the water, too weak to withstand the pressure from inside. The entire furnace must be lined with fire-brick. The destructive action of the flame on the brickwork has been much lessened, however, by the device introduced by the International Combustion Company, of two opposing flames entering from the side walls of the furnace and thus not impinging on the brickwork.

A COMPLETE PLANT FOR THE PREPARATION OF POWDERED FUEL.

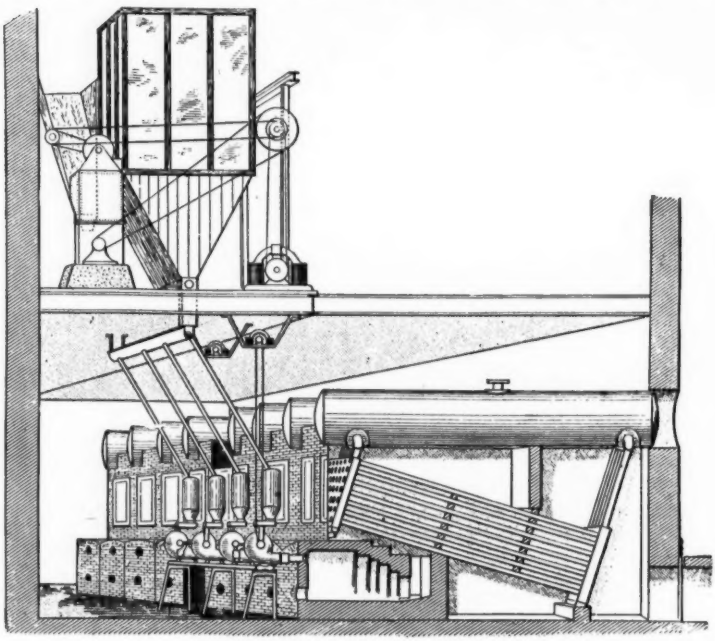
Installed by F. L. Smidth & Co. for the Glens Falls Portland Cement Co. One kominuter and one tubemill. The coal-grinding department is very free from dust.

The ash gives some trouble. It is apt to fuse on the tube ends, or to form a tough slag, not easily handled. With a non-fusing ash however, most of the incombustible matter will be deposited in the back end, from which it may easily be cleaned out, in the form of a light-colored uniform powder, bone dry, which has found an application in the arts as a parting sand for foundrymen. One sample of ash had a specific gravity of 2.50, a sliding angle with the vertical of 41 degrees, and analyzed as shown on the next page:—

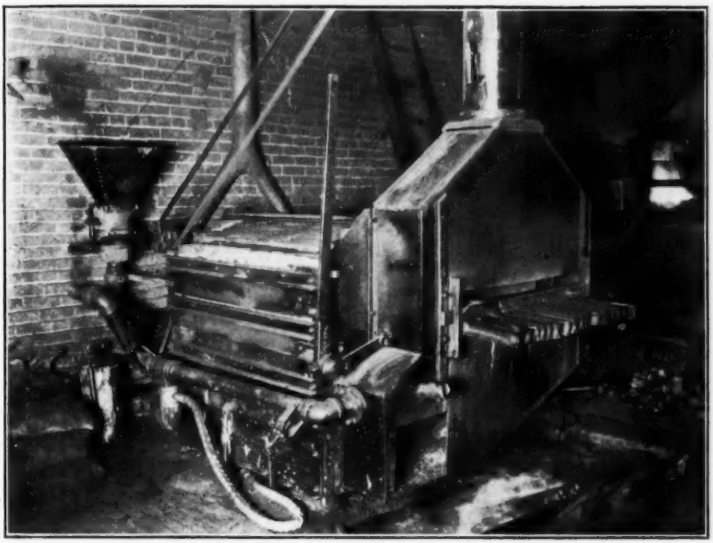
Si	50.40
Fe_2O_3	16.07
Al_2O_3	28.25
CaO	3.30
MgO	.76
Sulphates	1.13

Pulverized coal is smokeless after the brickwork is once heated. It can be burned with just sufficient draft to keep it in suspension. There is no fuel-bed resistance to overcome. While the equipment involved is expensive and elaborate and costly in maintenance, so also are many forms of mechanical stoker. There are no grates to renew. In case of a bad breakdown in the pulverizing plant, boilers can be quickly hand-fired with ordinary coal. Pulverized coal will bring a boiler up to pressure as quickly as gas or oil. The loss by fuel in the ash is very small, one sample of ash showing only ¼ of 1 per cent of combustible matter.

It is obvious that a finely divided dust, floated into the furnace,



SCHEMATIC DIAGRAM OF "CYCLONE" POWDERED COAL-BURNING SYSTEM.
E. H. Stroud & Co., Chicago.



FURNACE FOR HEATING PLOW BEAMS, BURNING POWDERED COAL.
Welles Fuel-Saving System, Chicago. Average weight of metal heated per pound of coal was 13.05 pounds. Average cost of fuel per 100 beams was 21 cents.

permits of more perfect mixture of air and fuel, and consequently of a decreased quantity of excess air and consequent higher furnace efficiency, than any form of solid fuel. That this has not been thoroughly demonstrated in practice on a wide scale is due to the hitherto limited application of pulverized coal. Tests have been made showing fairly high percentages of carbon dioxide; in one, this ran from 10.8 to 15 per cent, with gases at 450 degrees at the uptake, the boiler working at just about rated capacity. The average CO_2 throughout the test was 14.50, oxygen being reported at 4.25 per cent. The rate of combustion was equivalent to 21 pounds per square foot of grate per hour. Another test gave 14.34 to 14.47 per cent of CO_2, the exit gas being at 463 degrees. These are good results, even if not at all remarkable. The point is that with pulverized coal it should be easy to get good results practically all the time, while with ordinary coal it is only under perfect conditions and for short intervals that we can expect to get anything like 14 per cent of carbon dioxide. The fire from powdered coal, as viewed through a peep-hole, resembles an oil fire, being, if possible, rather better distributed. As with oil, the air supply should be cut down almost to the point of smoking, and to

effect this, tight ash pits with good doors are necessary. To give room for the flame from the highly volatile coal used, at least eight feet of length must be provided for combustion, and if the ordinary boiler setting does not furnish this, a "dutch oven" should be built out. The bridge wall has no other object, with this fuel, than to contract the flames up against the heating surface.

The first cost of a pulverizing plant depends entirely upon the degree of elaboration and duplication of equipment desired. For a single-unit system comprising dryer, pulverizer, conveyors, overhead bins and feeders, without outside storage, having a capacity of 4 tons per hour, the cost was $7,000. This is equivalent to $4.38 per horse power. A tube-mill installation having a capacity of 75 tons per day cost $70,000, or $23.33 per horse power. This involved duplicate equipment in pulverizers and driving engines, and a very extensive system of distribution over a wide yard area. A British estimate* for a plant having a capacity of 500 tons per week (say 1,400 horse power) was £2,880, or practically $10 per horse power. On account of the large size of some of the units obtainable, a plant for a small daily production would be relatively much more expensive. It is probably safe to say that a pulverizer plant should not in any case be installed at a works using less than 20 tons of coal per day, unless the conditions are unusual.

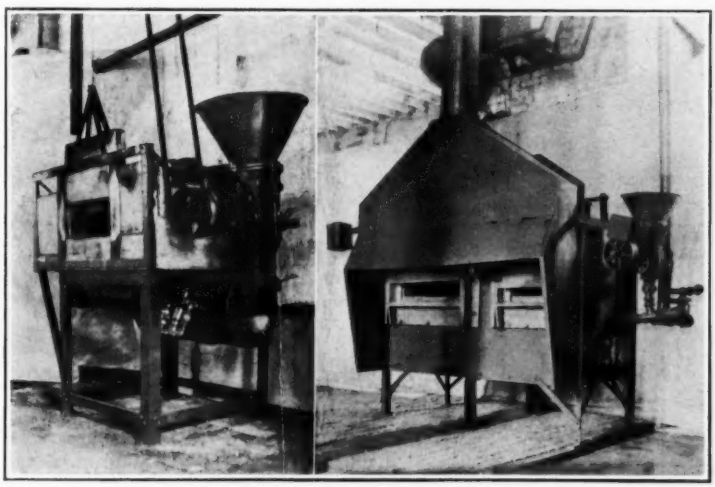
The cost of operation has been variously estimated. One writer† puts it at 35 cents per ton, and thinks that this amount is entirely offset by the saving in fire-room labor. A series of tests made at one plant, covering power and labor only, showed a cost of $0.2476 per ton for pulverizing, drying, conveying and firing. A cement works reported a cost from car to kiln of 35 cents, exclusive of fixed charges. My own approximate estimate, based on an actual output of 6 tons per hour, would be as follows:—

	Costs per Hour.			
	Power.	Labor.	Repairs.	Total.
Dryer, 9 horse power @ $.02	$0.18			
Dryer Fan, ½ horse power @ $.02	.01		$0.01	
Dryer Fuel, 1½ per cent. @ $3.00	.27	$0.60		
Pulverizer and Screen or Fan, 90 horse power @ $.02	1.80		.06	
Conveyors, say 12 horse power @ $.02	.24			
Feeders and Blast Fan, say	.20	.10	.01	
	$2.70	$0.70	$0.08	$3.48

* Address of W. R. Harrison before Leeds University Engineering Society, December 10, 1906, on Dust Fuel Stokers.

† W. H. Bryan, *American Machinist*, July 12, 1906, p. 52.

This is equivalent to $0.58 per ton, to which must be added the fixed charges. The British writer previously referred to estimates the cost at 15.37 d. per ton, including fixed charges, but he uses a cost for power of £4 per year, against our cost of $60, which I think more nearly approaches the average in manufacturing plants in the United States. Using our figure for cost of power, Mr. Harrison's estimate would be increased to about 46 cents per ton. A large iron works, using tube mills, found that the total expense, including fixed charges, was not over 60 cents per ton. My approximate estimate would therefore appear to be on the safe side. It is not safe, as a general rule, to assume that a cheaper grade of coal may be used by resort to powdering. This has frequently been found to be a delusion. On the other hand, pulverized coal should not be rejected on account of the high cost of installation alone. This cost is pretty closely comparable with that of mechanical stokers, when the overhead storage bins and expensive building construction necessary for stoker installations are considered.

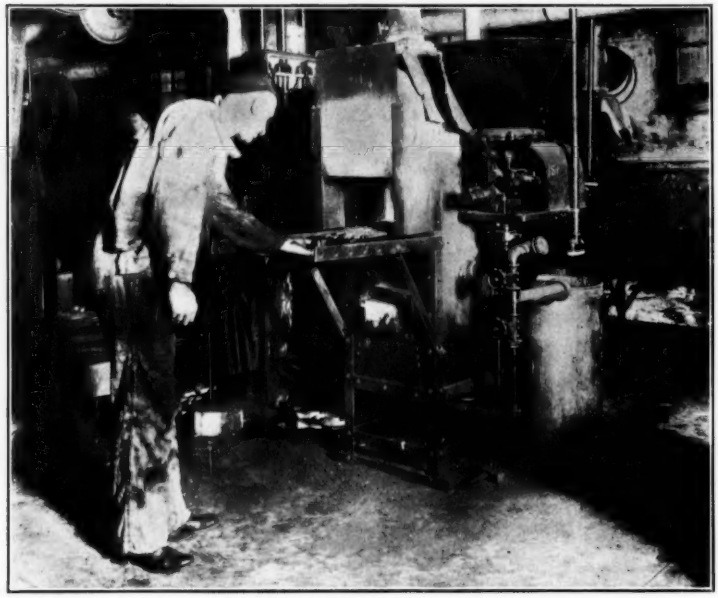


A SMALL FORGING FURNACE, AND A DOUBLE FURNACE WITH PRELIMINARY HEATING CHAMBER ON ONE SIDE AND FORGING FIRE ON THE OTHER.

Both burning powdered fuel on the Welles system.

To sum up the situation with regard to steam boiler practice, it would seem that the expense of pulverizing is not entirely offset by the saving in fireroom labor, under usual conditions. Assuming, however, a loss of 20 cents per ton due to the cost of pulverizing, this is a

small percentage of the cost of the coal as compared with the percentage to be saved by the more efficient combustion which powdered fuel induces. This more efficient combustion now so widely sought in boiler-furnace operation seems to be more readily obtainable by the use of pulverized coal than by any other method at present offered.



A POWDERED-FUEL BURNING BOLT FURNACE ON THE WELLES FUEL-SAVING SYSTEM.
Designed especially for making short heats on the ends of rods for bolt heads or similar forging work; 22 inches wide by 27 inches deep; length of heats, 3 inches.
Welles Fuel Saving System, Chicago.

In industrial applications aside from steam production, powdered coal presents great opportunities for saving.

One interesting metallurgical application is represented on page 585. This shows a plow-beam furnace on the Welles system in which 425 beams weighing 13,158 pounds were heated in 10 hours by 1,008 pounds of coal, costing when pulverized $1.80 per ton. This furnace replaced one which formerly used coke. With coke the production was 350 2¾-inch beams in 10 hours, the fuel consumption being 1,528 pounds, at a cost of $5.10 per ton.

A large forging furnace also equipped with the Welles powdered-coal system is stated to have been in operation for nearly a year and to

have effected a saving of 67 per cent in weight of fuel consumed. It was also claimed that the output was increased 50 per cent owing to the better regulation of heat. The furnace is used for heating ingots running in sizes as large as 15 inches square by 8 feet long.

In general, the slight additional cost for pulverizing is more than offset by the relatively higher price in most localities of either fuel oil or natural gas. In such special locations, for applications in which ordinary coal is impracticable, no fuel is as cheap as pulverized coal. Considerations of speed in production have led in metallurgical and other establishments to the widespread use of oil or gas even at a cost per heat-unit twice as great as that of coal. Powdered coal would be equally convenient and quick, and far more economical, for the operation of varnish kettles, annealing furnaces, drop forge furnaces, brass foundry crucibles, enameling furnaces, cable-coating machines, flanging furnaces, steam-hammer furnaces, rivet and bolt heaters, etc. The only possible competitor of powdered coal in these applications would be industrial gas. For the steam automobile, the dispensing of dust fuel from established depots would effect a saving of about 90 per cent in the cost of fuel, would permit of perfect regulation from outside, continuous and automatic feeding of fuel, high efficiency, smokelessness, and cleanliness.

EXAMPLES OF FAN-DRAFT TOWERS.

Above, a steel-encased tower of 50,000 gallons capacity; below, a wooden tower of 45,000 gallons capacity; both with chimney connections. George J. Stocker, St. Louis, Mo.

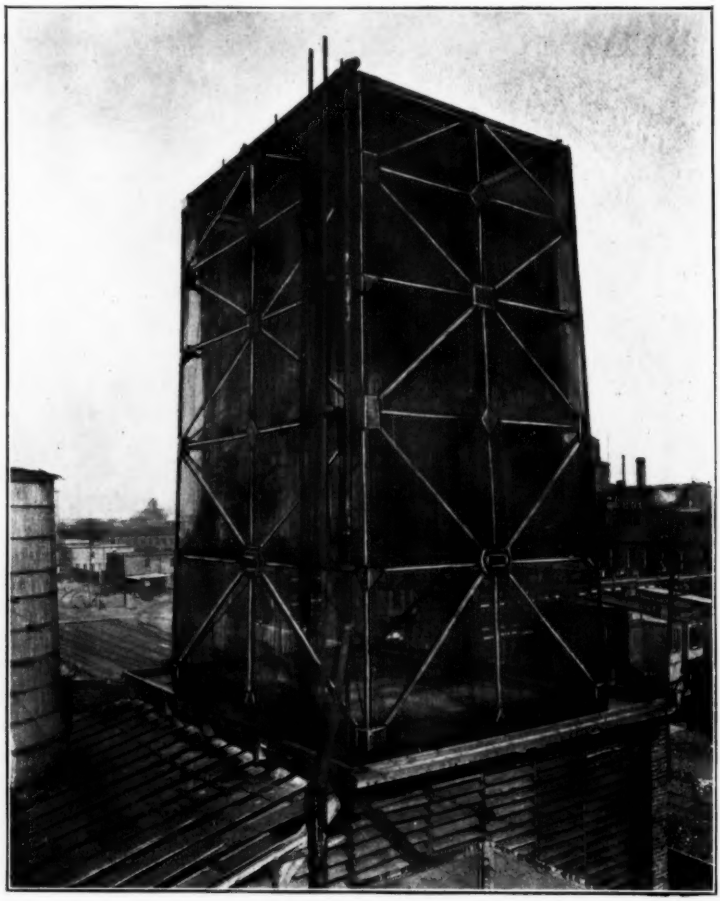
COOLING-TOWER PRACTICE.

By Dr. Jos. H. Hart.

COOLING TOWERS, as an engineering development, have passed the experimental stage. Their application is rapidly increasing and their standardization of form is steadily going on. Owing to the novelty of the subject to the majority of engineers, and the growing importance of the device with its wider and wider application, a complete review of the entire field is not inappropriate here.

The term "cooling tower" is descriptive of the nature and purpose of the device. It consists essentially of a tower-like structure as used for the cooling (at least theoretically) of any material. Its application, to this date, has been confined exclusively to the cooling of hot water. Cold water is a necessary condition for operation in many industries of the present day. In power plants, or in factories where the production of power is quite large, cold water is essential for the operation of the steam condenser. In refrigerating plants cold water is also used in the operating of the condenser, if of the compression type, and in the operation of both the condenser and absorber, if of the absorption type. In gas-engine operation, water is required for circulation to keep the cylinder walls comparatively cool so that the benefits of lubrication may be secured. The quantity approximates 8 or 10 gallons per horse power per hour, and with large engines dependent upon city service for supply this would be an appreciable addition to the cost of operation. Well waters are further often ill suited to this purpose on account of contained salts which deposit in the water spaces and impair the efficiency of the cooling. In either case, the use of a cooling tower eliminates 90 to 95 per cent of the difficulty. While these applications represent the chief demands today for cold water as an absolute necessity, without which the plant cannot operate without great loss in efficiency, and in some cases not at all, there are many other applications in which similar conditions are steadily approaching.

Wherever cold water in large quantities is needed, and whenever this water becomes unserviceable when heated, a cooling tower becomes an absolute necessity for the best economic operation even when



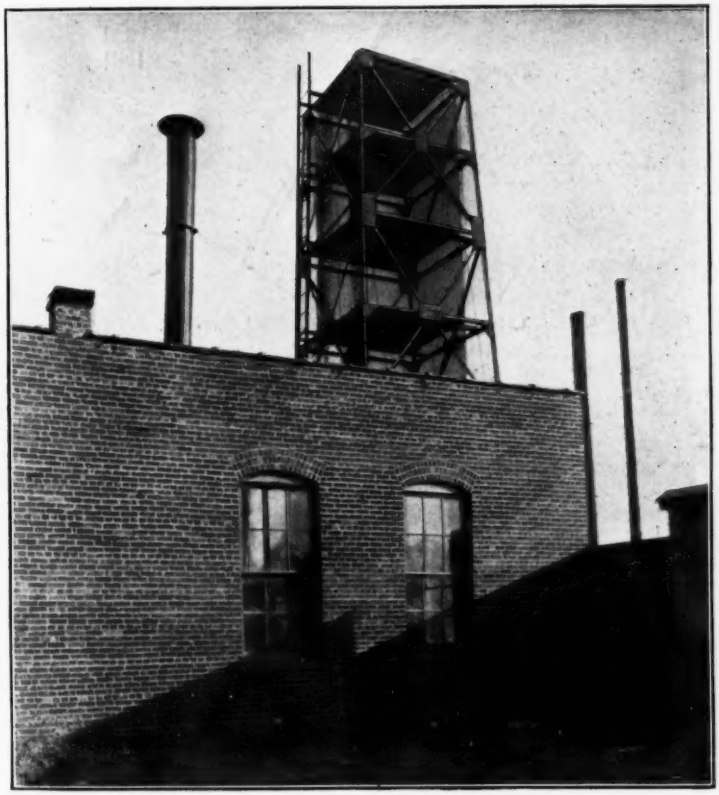
OPEN TYPE COOLING TOWER FOR 50 GALLONS A MINUTE.

For cooling water for a gas-engine installation at the plant of Chas. Mundt & Sons, Jersey City, N. J. Edwin Burhorn, N. Y.

cold water can be obtained for much less than the ordinary rates holding in the large cities.

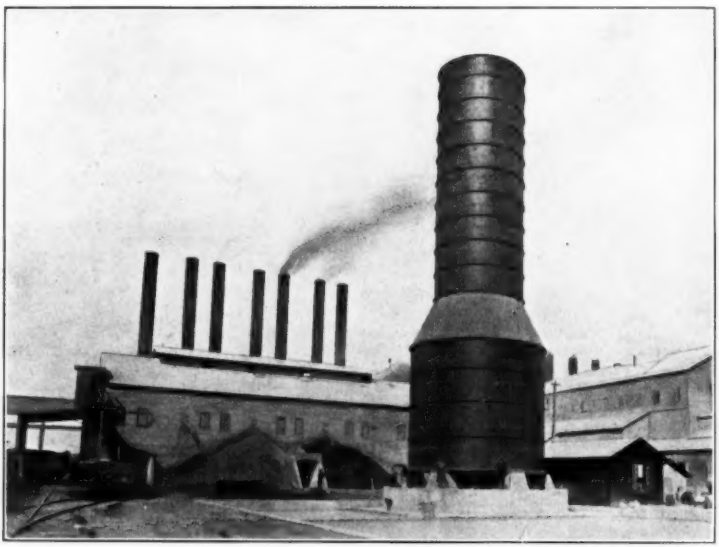
In general, there are two kinds of cooling towers which have been developed as the result of experiments and use. These are called, respectively, the closed-tower type and the open or atmospheric type. Of each of these two types there are many variations on the market, but the differences appear chiefly in the details of construction

and cost of erection. These two types are essentially the same in many respects; they both consist of square or rectangular towers rising into the air from 20 to 60 feet, and both have water pipes extending to the top of them, with various sprinkling devices at these points. The water in all cooling towers is cooled primarily by evaporation into the surrounding air. The closed type differs from the open one, in theory at least, only in the fact that the sides are closed, and the contact of the water with the air is accomplished by means of a power fan situated at the base. The atmospheric type, on the other hand, has the walls of the tower entirely open and admits air from all sides into immediate contact with the water. All cooling towers invariably have pans or obstructions interposed in the path of the water, with the object of



A BURHORN COOLING TOWER AT THE PLANT OF THE JEFFERSON ICE CO.

detaining it in its passage downward and dividing it into smaller units, with the object of promoting thorough and continuous contact with the air at all points. The modifications of design and construction distinguishing various towers in every case consists essentially in the variations in the sprinkling device at the top, in the details of the obstructions in the path of the water used for detaining and subdividing it, in the collecting pan at the bottom, and in the situation of the pan, if one is used, for producing greatest efficiency. Open-type cooling towers are sometimes partially covered with wire netting or provided with special appliances to prevent high winds from carrying off a large portion of the water in its downward fall.



CLOSED-TYPE COOLING TOWER, LEHIGH PORTLAND CEMENT MILL, MITCHELL, IND.

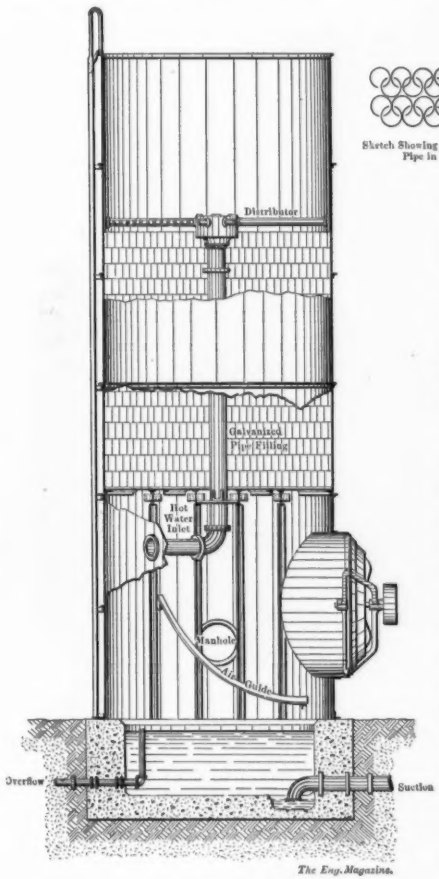
Henry R. Worthington, Inc., N. Y.

The principle back of the cooling tower, as has been said, is based upon the absorbing power of air for water vapor and the consequent cooling of the water from which this vapor is obtained. Cooling by this process is much greater than any other; the latent heat of water enters as a factor here with remarkable results. A pound of water changed to steam absorbs 966 B. t. u. It does this whether heated or not, provided only the change to vapor is accomplished; and if the heat is not supplied otherwise, the change to vapor which demands it

is accomplished by absorption of heat from surrounding bodies, thus producing in them a cooling effect. Thus water subjected to a strong wind undergoes rapid evaporation, and its consequent cooling follows as an immediate result. It has been shown recently that the great bulk of natural ice is produced by this process, and very little by conduction of heat.

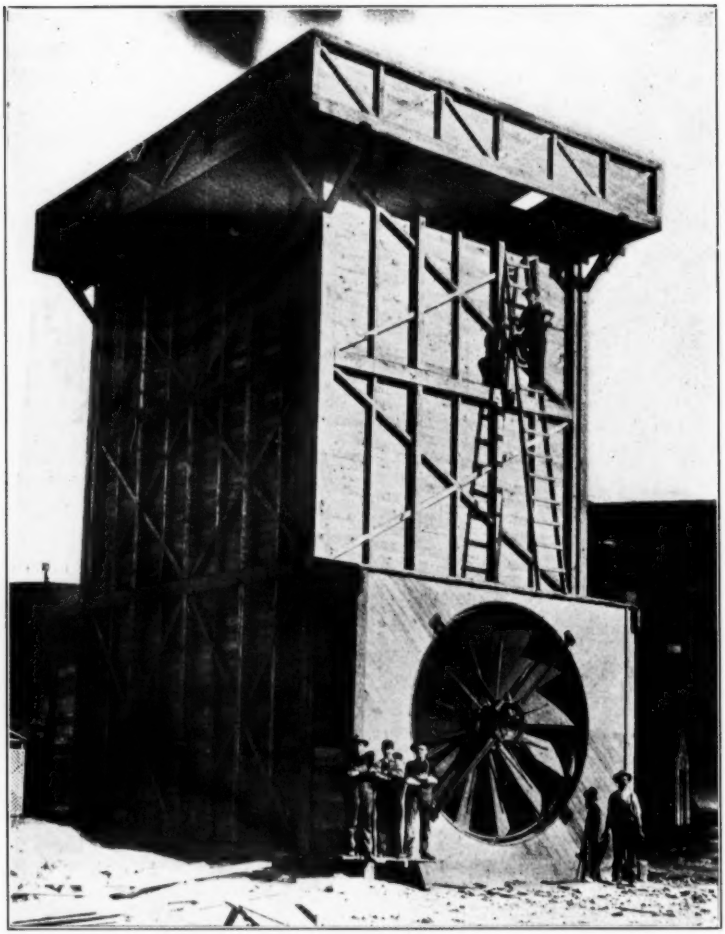
Cooling towers, then, depend for their operation absolutely upon the extent of the vaporization produced in the water during its passage through the tower. Thus, about 5 per cent of water must be lost by evaporation in a single passage through the tower, to cool the residue from 120 degrees to 80 degrees F. Thus cooling towers do not absolutely eliminate the demand for water by plants in which they are operated; they merely diminish the amount required.

Sketch Showing Interlocking Pipe in Tower



SECTIONAL VIEW OF WORTHINGTON COOLING TOWER, FAN TYPE.

Their efficiency, therefore, depends primarily upon the cost, availability, and temperature of the natural water supply, and further, in a general way, upon the cost of fuel and labor for the maintenance of the pump, and (if the tower be of a closed type) of the power fan. Interest on first cost and cost of maintenance must also be considered. Where plants demand a large amount of cold water and are situated in large cities, without a supply immediately available at a low

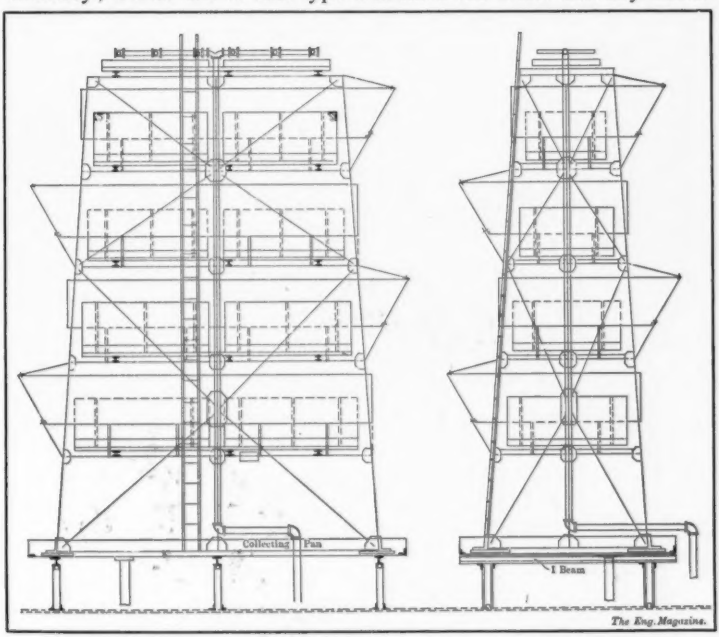


WOODEN FAN-DRAFT TOWER OF 100,000 GALLONS CAPACITY.
George J. Stocker, St. Louis, Mo.

cost, the towers are undoubtedly very economical, absolutely cutting the consumption of water down to only 5 or 10 per cent of its former amount; and when very large quantities are considered at ordinary supply rates, the cost of operation and installation of a tower compares very favorably with the reduction in the water bill. A saving of 50 per cent in this item is not uncommon in many large plants where

such appliances have been installed, and this figure may rise much higher when the installation is under the charge of a competent engineer.

It may be assumed in a general way that a tower 20 by 20 by 40 feet high, has usually a cooling capacity of 300 gallons per minute, from 120 degrees to 80 degrees F. This is the approximate performance of the average cooling tower, but it is dependent absolutely upon hygrometric conditions in the atmosphere. Conditions vary so widely that no general statement can have much value. If the air contains a large amount of moisture, or rather has a relatively high humidity, the cooling-tower loses much of its efficiency. By humidity is meant the ratio of the amount of water vapor in the air to that which it could contain without precipitation at that temperature. This, of course, represents the power of the air to absorb water vapor and produce cooling effects. It is only fair to say that on hot moist days, when the humidity is high, the cooling tower diminishes very greatly in efficiency; a machine of this type will have the water scarcely below

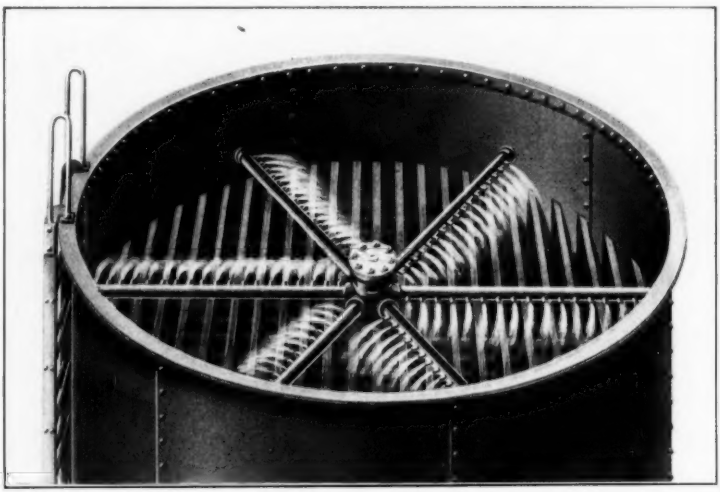


HART COOLING TOWER WITH SECTIONAL TRAYS AND SPRAY PREVENTERS.
B. Franklin Hart, Jr., & Co., N. Y.

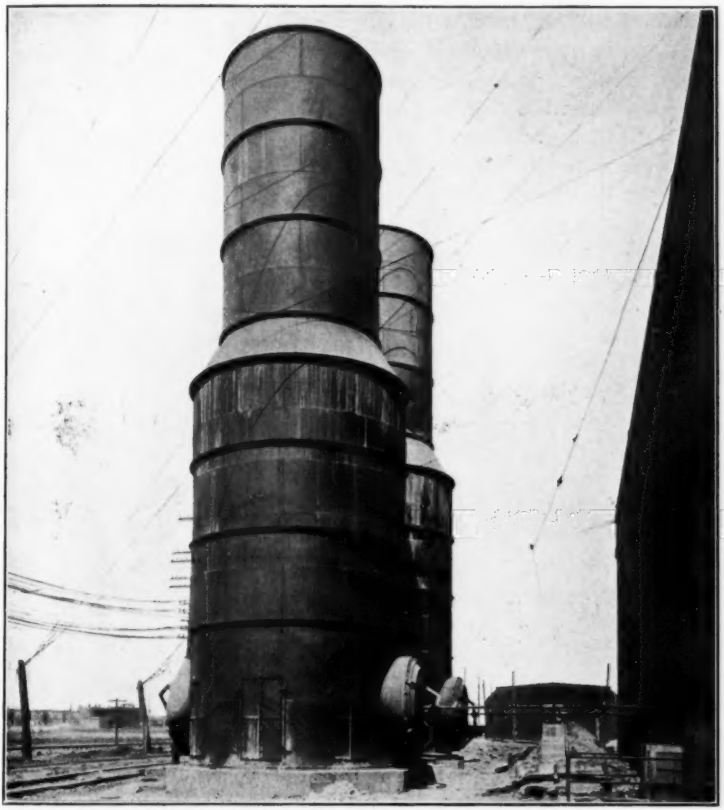
100 degrees F. in these instances, thus undergoing a loss in efficiency of about 50 per cent. It must be understood, in fact, that cooling towers depend absolutely for their effect upon the absorptive power of air for water vapor to produce the cooling, and not at all upon the radiation of heat or conduction into the atmosphere. Thus the operation of such a tower is much more efficient on a dry, hot day than it is upon a cold wet one.

OPEN TYPE COOLING TOWER EQUIPPED WITH HART SPRAY PREVENTERS.

In comparing the relative efficiency of the two designs, it was formerly supposed that the closed type was superior. The cooling effect, however, depends merely upon the quantity of water changed to vapor in the atmosphere. This later depends upon the relative efficiency in this process of a unit of air, and upon the number of



TOP OF AN ALBERGER COOLING TOWER, SHOWING THE DISTRIBUTING SYSTEM.



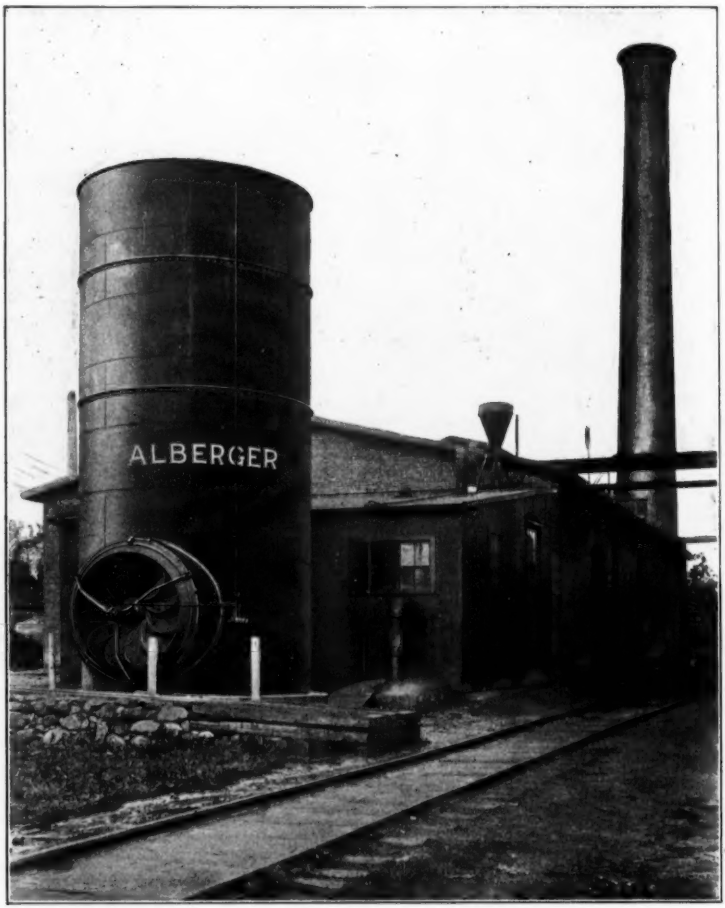
CLOSED-TYPE COOLING TOWERS AT THE POWER HOUSE OF THE EAST ST. LOUIS & SUBURBAN RAILWAY.

Alberger Condenser Co., N. Y. The towers are to take care of 50,000 lb. of steam per hour and give 26 in. vacuum with air at 80 degrees F. and 70 per cent. relative humidity.

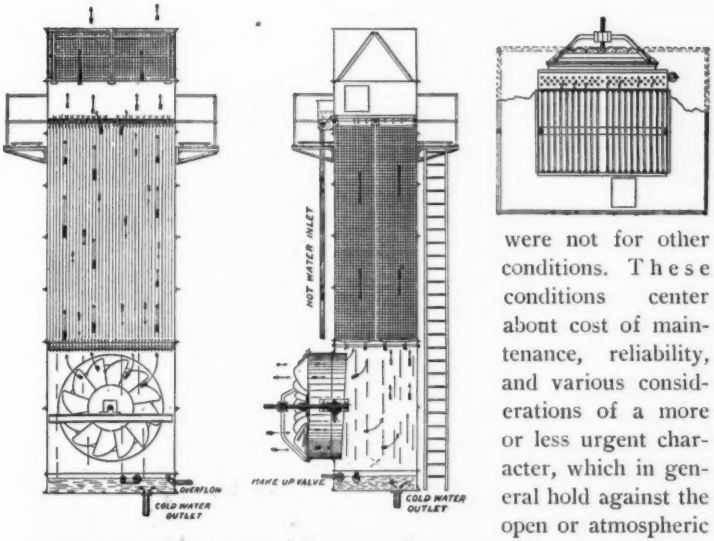
units of air operated upon per unit of time. The closed type, with a powerful fan, was supposed to convey much more air over the surface of the water than was the case in the open or atmospheric type, where this transfer of air was dependent upon natural causes. However, it has been found that air in contact with water rapidly attains a saturated state, and thus the air from the fan in its passage over a great amount of the water is absolutely ineffective in producing vaporization, since it becomes saturated almost immediately upon contact with the water. Hence it is recognized today that the atmospheric type is superior in efficiency, from an operative point of view, in the cooling

mechanism. The fact that the operation of the fan requires power, and that this latter must be considered as a cost factor in the operation of the plant, has enabled the open cooling tower to compete successfully with its rivals.

The closed type of tower may triple, or even quadruple, the first cost of a tower of the atmospheric or open type; and hence, its efficiency being less, it would soon cease active competition if it



FAN-COOLED TOWER, ROCKLAND LIGHT & POWER CO., ORANGEBURG, N. Y.
Alberger Condenser Co., N. Y.

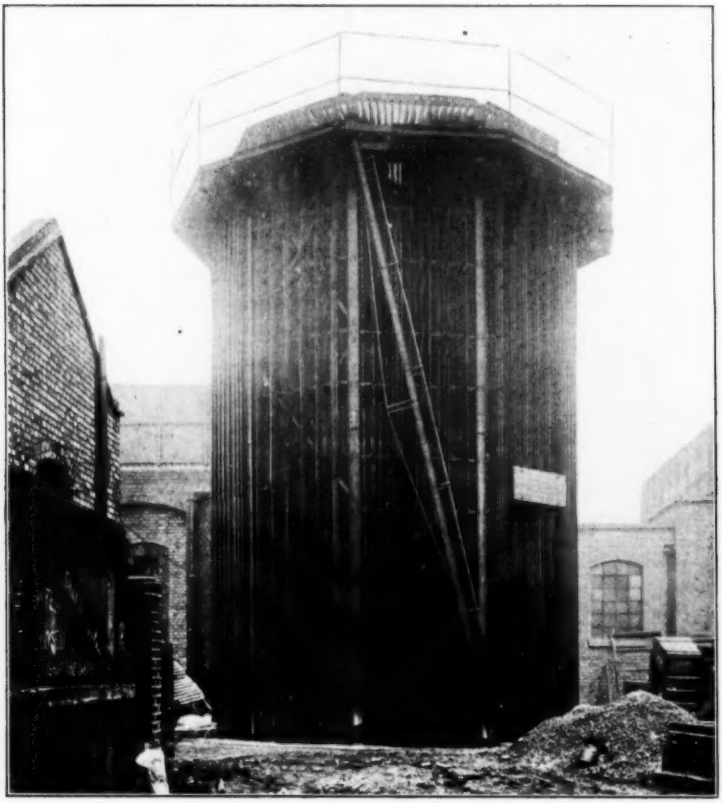


SECTIONS AND PLAN, WHEELER COOLING TOWER.

were not for other conditions. These conditions center about cost of maintenance, reliability, and various considerations of a more or less urgent character, which in general hold against the open or atmospheric type.

In point of maintenance, there is no doubt that the closed type is much superior in constructive details and in its general development. It costs more to erect, and this cost is not altogether on account of design. It must, from the nature of the design, be made up of much heavier material and is, in general, a much stronger and more permanent tower. With its closed sides it is not nearly as subject to weather conditions and the deteriorating effects which result from these.

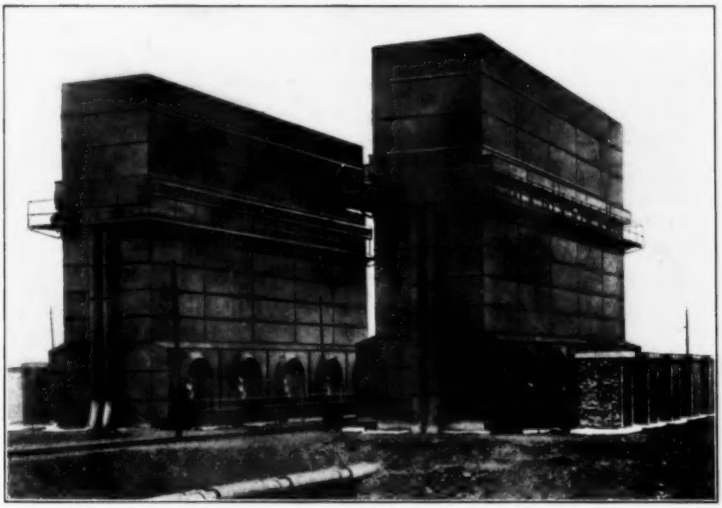
So far as concerns reliability in performance, a cooling tower of the open or atmospheric type has a certain definite capacity for cooling water under any given set of weather conditions, which natural capacity cannot be exceeded, and its performance is thus dependent to a greater extent upon the hygrometric conditions existing in the atmosphere at different times. Thus the quantity of air coming into contact with the water is dependent upon the wind, and its efficiency varies with its humidity. Under certain conditions, the closed tower may become more efficient because it is more adaptable; it is not dependent upon the wind for a supply of fresh air, and the ill-effects due to a bad hygrometric state of the atmosphere can be offset by measures which reduce them to a minimum in this type. Under such conditions, a speeding up of the fans, with the resultant increase in air supply, will often compensate for a high hygrometric state, thus rendering the operation of the tower more nearly uniform.



OPEN TYPE COOLING TOWER FOR 600 GALLONS PER MINUTE.
For a plant using about 5,000 lb. of steam per hour. Wheeler Condenser & Engineering Co., N. Y.

Now we come to a further objection to the open type of tower which often becomes of paramount importance. This is due to conditions existing in large cities and is certainly one for serious consideration. An open tower of ordinary type loses a large amount of water as waste when a high wind is blowing, because it escapes from the tower through the sides. This is sufficient to wet thoroughly much surrounding property and in some cases this has been the cause of damage suits; in any case, it invariably hastens the deteriorating effects of water and moisture on the surrounding property. In some forms of construction this difficulty is met and removed by providing the tower with systems of spray guards.

Thus we see that each type represents a different field with its own advantages and disadvantages. The closed type is efficient and reliable—not as efficient at its best as the open one, but more reliable. It costs much more to install, but complicated conditions are not apt to arise in its maintenance, other than those of a mechanical nature. The open-type tower, on the other hand, requires no machinery in its operation, and is the most efficient under ordinary circumstances. The result has been, as would be supposed, that large and efficient plants, with considerable capital and knowledge back of them, have almost invariably installed the closed type. Smaller units, in which cost is an important consideration, have installed the open type. Thus large power stations, operating trolley and lighting systems in the large cities very generally have cooling towers of the closed type. Small



COOLING TOWERS FOR 320,000 POUNDS OF STEAM PER HOUR.
Two sections of five fan-cooled towers, each unit having two 120-inch fans requiring 23 brake horse power. Installed at the Liverpool Corporation Electricity Supply Works by the Wheeler Condenser & Engineering Co.

refrigerating plants almost invariably adopt the open one. Plants midway in this category are variable in their choice. Sufficient to say here, merely, that both types are in active and efficient operation today; that their use and application is daily becoming more and more extended; that their principles are becoming more and more understood, and their design is tending toward a general standardization. The most successful forms on the market now, are comparatively few, and a process of elimination is continually going on.

THE THIRD-RAIL PROBLEM.

By A. D. Williams, Jr.

Mr. Williams' paper takes up certain physical problems of steam-railway electrification in the same spirit that characterized Mr. Knowlton's discussion of organization problems in our preceding issue. This is the spirit of frank and full recognition of the difficulties, and their clear definition so that they may more speedily be recognized and solved. The great movement (in which these and any other difficulties are but questions of detail to which an answer will be found) will progress all the more surely and speedily thereby.—THE EDITORS.

ONE of the questions to be answered after a decision has been reached to adopt electric traction, is the method to be used for delivering the electric current to the train or locomotive. Two methods are at present available for this purpose, each having some advantages and disadvantages; these are the third rail and the overhead trolley wire. To those who are unfamiliar with the actual operating conditions of main-line railroad operation the problem is simplicity itself; the railroad executive must, however, take many items into consideration before reaching a decision on this simple little question. Many of the conditions brought forward by the long-headed railroad man may seem to have but a trivial bearing upon the subject at issue, and while they are of great importance on the main highways of traffic, these items are not considered by outsiders. The cost of a mistake, however, will be enormous and a serious handicap to the road.

In the past, electric traction has been limited to a very narrow field; tramways in cities and towns, urban and interurban service using multiple-unit and individual motor cars, and some electric locomotives, are in use. In all of these lines single or double-track operation exists using a special size of dwarf car, and the problem is of a comparatively simple nature when compared with the difficulties to be surmounted prior to the successful application of electric traction to the full-size requirements of a trunk line or the problems of a heavy terminal traffic. In this latter field it is impracticable to adopt the multiple-unit cars, except for the suburban zone passenger traffic, and the main difficulties lie in the satisfactory solution of the problems arising from the through passenger service and freight traffic. Of necessity this traffic must be handled

by a locomotive of some type. The change from steam to electric operation must be effected with the minimum amount of delay to traffic, and the installation must be made at points where the existing facilities are already taxed to the breaking point. For these reasons the system adopted must be one about which there is no tinge of experiment, and the price of a failure cannot be computed in dollars and cents.

In dealing with heavy traffic it is of the utmost importance that it be kept moving, and the only excuse which the railroad man will consider valid for the absolute interruption of the flowing stream is the total loss of the roadbed and track. When traffic is blocked the first duty is to open a way past the obstruction and to get things moving. This is more important than anything else. After this has been done other tracks can be cleaned up. In doing this, temporary work of the most hasty character is required, and the system of electrical distribution must be such as will lend itself readily to this purpose. This system of distribution must be devised to permit of all kinds of irregular operation and total reversal of the direction of traffic; it must not interfere with the operation of signals or obscure their visibility, particularly on lines where high schedule speeds are required. The conductors supplying currents to the trains and locomotives must be so located that all turnouts and cross-overs, no matter how infrequent the likelihood of their use, can be negotiated at all times with the train under complete control. No conductor that has a gap which must be jumped complies with the conditions, and the conductor which cannot be readily restored to working conditions after a wreck does not meet the requirements. The conductor must be susceptible of emergency repair with materials which may be readily carried by the wrecking equipment, without adding unduly to the outfit. In this connection it must be borne in mind that the scene of a wreck cannot be selected in advance, and the amount of temporary work required cannot be limited by written orders and instruction books. The trouble must be handled right on the ground; and there will be no opportunity to request bids on the material required.

Another point to be considered is the obstruction offered by the electric conductors to wrecking operations, and the facility with which portions of it may be torn out and re-established. Large gangs of men and heavy cranes must be used in wrecking operations, and the danger of the work must not be increased by mysterious electrical displays, otherwise it will be impossible to keep the labor on the job.

In terminals and yards, where dense traffic must be handled, it is

absolutely essential that the electric conductor should add as little as possible to the ordinary complications and dangers inseparable from present methods of operations. Cumbersome and makeshift constructions should not be countenanced. In such places trains must be made up and handled, frequently with urgent haste, at night as well as by day, and a conductor so located that it interferes with or increases the hazard of operations is matter out of place.

The improper location of the conductor also produces serious troubles with regard to maintenance-of-way operations. Track must be continually lined in and levelled up. This work must be carried on under a traffic which cannot be slowed up or stopped for a gang of men to get their tools out of the way, and is never absolutely suspended. On a one- or two-track road, with infrequent trains, this is one sort of a proposition; on a four-track line, with seven or eight hundred train movements, the problem is not a simple one at the best.

The operation of a line dealing with all classes of traffic and handling hundreds of trains per day is a vastly different problem from that met in the handling of a dense traffic of a single class, as on the elevated lines and subways of large cities; and these differences are much greater than those between the little single-track interurban road and the latter. It is in these differences that the difficulties lie. In the latter two cases there is the added advantage in handling the problem that a dwarf variety of equipment is to be dealt with, and in addition the roads are usually designed with the idea of electric operation. In the application of electric traction to an existing railroad, designed for steam operation, there are many obstacles to overcome. The electric equipment itself may not cost as much as the alterations necessary to permit the use of electricity. Most of these lines were laid out years ago, and the gradual growth in the size of cars and locomotives has encroached on the originally ample clearance lines, until today there are many roads that are unable to admit heavy freight cars and the large private and Pullman cars to certain portions of their lines; the clearance between tracks has been shaved to the limit and equipment is frequently damaged at tight places. Necessarily, the only successful method of eradicating the trouble is the expensive one of revising the line, and while this is not an impossible task, it would be an extremely costly proceeding. The principal difficulty in the way of such revision, naturally, lies in its cost; in addition there is a certain lack of initiative on the part of those in authority and a fear of departing too far from the antiquated standards of the past.

A peculiar fact in regard to many railroad standards (?) is the number of different standards, the same road having several standards for certain constructions, each in use on separate portions of the line and all out of harmony with one another. This is due to corporate consolidations which have not as yet coalesced throughout. In many cases these out-of-date standards are blindly followed in absolutely new construction, where unbiased consideration and the ability to view matters with a broad perspective would show the futility of clinging to the past and the advantages to be gained by throwing deadwood overboard. Unfortunately, there is sometimes a certain lack of co-operation between the various departments of railroads, each department and sub-department striving for its own individual record without regard for others or for the ultimate result. When such departmental jealousies are rife the interests of the road suffer.

In the location of the electric conductor several things must be considered, particularly clearances; two bodies cannot occupy the same space at the same time. The clearance question is one of the most difficult problems the railroad is called upon to solve. Clearances which were ample for the equipment of forty years ago are inadequate for the equipment of today, and on some of the older roads the maximum equipment line is so close to existing structures that further encroachment, by additions to either structures or equipment, is impossible.

The maximum equipment line is supposed to represent the composite cross-section of the largest locomotive, the largest freight car, the largest private car or Pullman, the largest wrecking crane, the largest snow plow, in running condition with markers in place; this cross section being increased by a sufficient amount to cover the side sway permitted by the truck bolsters, lopsidedness due to a broken spring, eccentric loading bringing the car down on its side bearings, journal play and wear. The effect of curvature of the line must also be considered. Necessarily, any conductor conveying current to a locomotive or car must be outside of this line by an amount sufficient to provide a working clearance. The current collectors must be capable of reaching this conductor and of being housed within the maximum equipment line.

The table on page 658 gives the location of the third rail on a number of installations; of the American examples given the first two and the last two are the only ones which deal with full-sized railroad equipment. As will be noted, the Baltimore & Ohio has made a change in the location of the third rail, moving it out 6 inches. This

was done in order to clear equipment that was kept off of this portion of the road by the previous location of the third rail. When the under-running third rail was first proposed it was suggested that the location suggested, 2 feet 4¼ inches from the gauge line, be adopted as a standard, as it was supposed that this was outside of the maximum equipment line; but in applying electric traction to another division it was found advisable to move the third rail 3¾ inches further out in order to clear equipment. This change would prevent an uninterrupted interchange of traffic between sections of road equipped with these rails. The move outward was forced by the fact that the original location cuts into the equipment line, and this has caused rigid inspection to be made of all trains coming into the electric zone.

TABLE GIVING THE LOCATION OF THIRD RAIL ON VARIOUS ROADS.

Name of Railroad.	Top of Third Rail above Top of Running Rail. Inches.	Center line of Third Rail outside of Gauge Line. Inches.
Baltimore & Ohio (Old)	1¾	24
Baltimore and Ohio (New)	3½	30
New York, New Haven & Hartford*	1½	Center line track
Paris-Orleans Railway	7⅞	25⅝
Milan-Gallararate Railway	7½	26 9/16
Mersey Railway (Liverpool)	4½	22
North Eastern Railway	...	19¼
Paris-Versailles Railway	7⅞	25⅝
Fayet-Chamonix Railway	9	23
Wannseebahn (Berlin)	12⅝	33½
Albany & Hudson	6	27
Aurora, Elgin & Chicago	6 5/16	20⅛
Lackawanna & Wyoming Valley	6	20⅜
Grand Rapids, Grand Haven & Muskegon	5¾	20⅜
Seattle & Tacoma	7½	20
Columbus & Newark	6	27
Columbus, London & Springfield	6	27
Metropolitan Elevated (Chicago)	6¼	20⅛
Lake Street Elevated	6½	20⅛
South Side Elevated	6¾	20⅛
Southwestern Elevated	6½	20⅛
Brooklyn Elevated	6	22¼
Kings County Elevated	5¼	19½
Boston Elevated	6	20⅜
Manhattan Elevated	7½	20¾
Central London	1½	Center of track
New York Central Under-running	2¾†	28¼
West Shore Div. New York Central	2¾†	32

While insulation troubles lie entirely within the province of the electrical engineer, the breakage of insulators is another question. If

* Abandoned by order of the Superior Court of the State of Connecticut, dated June 13, 1906.

† The last two are under-running rails and the dimension marked is from top of running rail to contact surface of third rail.

it were possible to prevent equipment from striking and breaking insulators there would be very little third-rail leakage. This leakage may, however, reach a serious figure when a large number of the insulators are cracked.

In connection with maintenance of way, the third rail adds a little to the trouble in keeping the track in line, as it obstructs one side. In addition it reduces the efficiency of the track gangs and adds a little to the expense of keeping them supplied with tools, and the incidental fireworks it furnishes demoralize the labor gangs. It would seem that with the third rail secured to the same ties that carry the running rails, their relative locations, with regard to each other, would be easy to maintain. The third rail is, however, not secured to every tie, but only to every fifth or sixth tie; and while the lateral variations are but slight there is the opportunity for considerable vertical play. When a train moves along a track each pair of wheels causes a wave in the track, the vertical amplitude of which depends upon the elasticity and softness of the road-bed. Deflections of as much as 2 inches are not uncommon on lines laid with 100-pound rails and broken-stone ballast. A third rail is affected by such waves, and has a certain amount of motion with regard to the track. With a top-contact third rail this motion does not affect the shoe contact to any extent owing to the large amount of play allowed for. With an under-running third rail a different condition occurs, as the motion of the shoe is limited, owing to the fact that it was considered necessary to use a shoe which would permit equipment designed for use on the under-running third rail to pass on the lines equipped with a top-contact protected third rail. To fulfil this condition, the normal position of the shoe is horizontal, and the top-contact rail forces it up, the under-running rail pressing it down. This limitation of the shoe motion must result in great variations in shoe pressure, which are made apparent by the sparking that takes place.

At stations the public must be looked out for, owing to the fact that many people indulge the habit of poking at things with umbrellas, canes, etc. An umbrella with a steel rod possesses interesting attributes as a pointer around a live third rail, and its convenience for the purpose will be felt in the claim department. As it is practically impossible to protect the shoe and its holder by a "fool-proof" guard, it becomes necessary to construct special station platforms at the level of the car platform. Where low platforms are in existence it is necessary to provide a dummy third rail, which is only a partial protection to the public.

From an operating standpoint the third rail is a menace and a constant source of danger to the trainmen, particularly at night. Circumstances often require that a trainman should go back with a red light to protect the rear of his train. Without the third rail there was a certain amount of risk; with it there is a positive danger. A broken leg with the opportunity to get run over by a following train is one of the probable rewards of obedience to the rules. This danger is a vivid reality to all experienced trainmen who have had the opportunity to observe working conditions on a third-rail line. A few accidents to the rear trainman will cause such men to become chary of risking their lives by going back at night. The number of railroad employees killed in the discharge of their duty is large, and many laws have been enacted forcing the railroads to adopt safety appliances. In view of this it would certainly be unfortunate for a road to adopt a method of electric traction which will ultimately be prohibited by law; in fact, the third rail has already been placed under the ban of the courts in Connecticut, owing to the large number of accidents due to its use. The third rail is bad enough along the line, but when installed in a yard it becomes a constant source of danger to all who are employed in such yards, obstructing all of the fairways and reducing the speed with which trains can be sorted and made up. Supposedly dead sections come to life the instant any gap is bridged, and the results of such mishaps have been spectacular in some cases and startling in others. In one case a laborer was electrocuted eight miles from the nearest live third rail, owing to a train over-running a gap.

In sorting yards the men will quickly learn the dangers of the third rail, and instead of riding their cars to the last minute and holding them will be forced for their own protection to drop off at the first sign of danger. The results of their caution are bound to be felt in a large increase in the number of minor smashes which occur. Individually each item is small but the aggregate will be large. The railroad pays for the cars that get smashed, but the employee has to pay for his own repairs. The natural results will be that the man will look out and get clear without trying to prevent impending smash ups.

In connection with wrecking operations the third rail presents considerable difficulty. The first result of a wreck is a short circuit cutting off all current in that block until the third rail has been cleared or re-established. This is a good point, but it makes it absolutely necessary to depend upon steam for handling the wrecking equipment. In addition another extra must be got out to handle the third rail. The third rail weighs from 40 to 70 pounds per yard and cannot be

put in until the track has been placed. Brackets and insulators are required about every 10 feet, and it takes considerable time to line the third rail in and get it covered. In the meantime traffic will have to be towed past the gap by steam locomotives, which will mean keeping a number of such machines on hand for emergency use. It may be necessary to handle all passing traffic on one track; this would be troublesome on a four-track road and worse on a double-track line. Any attempt to run a track around the wreck would be handicapped by the necessary third-rail construction; it would not be impossible, but it would require so much time that it would not be feasible. During the entire time the wreck was being cleaned up current would have to be kept off of that section of the road, as it would be impracticable to run the risk of stampeding the large labor gangs required by any spectacular electrical displays.

One of the worst features of the third rail arises from the fact that it is necessary to have turnouts and cross-overs and ladder tracks. These gaps are often as long as 150 feet. A double ladder track with double slip switches is one of the necessities of any yard or terminal, and in some cases triple ladders are used. These tracks cannot be operated by any third rail yet devised. The terminals for heavy traffic are of necessity of the stub-end or through type. The loop terminal, that happy solution of the little, dwarf multiple-unit road's trouble, is impracticable for full sized equipment. Furthermore the loop system is not adapted to holding trains in the terminal, often for several hours, as is necessary at night on all roads.

Another trouble liable to occur on a road is for a number of trains to get bunched, owing to an open drawbridge, for instance. When fifteen or twenty trains get closed up tight on each other it is very liable to lead to trouble at the rotary converters.

In dealing with the gaps at switches it has been necessary to use an overhead conductor. When this is of the low-tension variety and the supports have to span several tracks, supporting a conductor over each of them, it is extremely difficult to devise such a support as will not obstruct all views of signals. These overhead conductors must overlap the third rail at each end of the gap in order to guard against all possible chances of a train becoming stalled at such a point, for though the ordinary operating speeds at such switches and cross-overs may be ample to carry a train over the gaps, there is always the possibility of an emergency arising when trains must be under absolute control. In railroad parlance this means the ability to stop immediately, and to start from such a stop, as well as the ability to in-

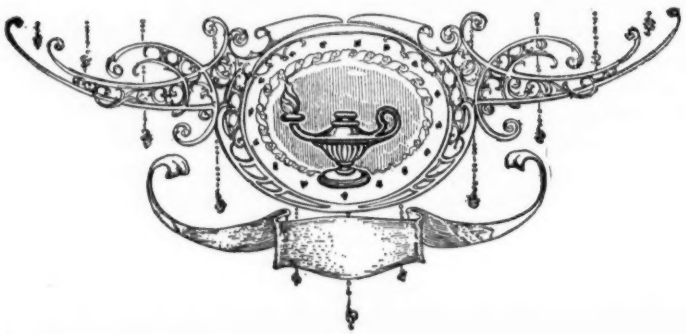
crease the speed. The necessity of the overhead conductor has been recognized in the largest installation of third-rail handling standard railroad equipment.

A feature not heretofore mentioned is the fact that at certain points it is necessary to locate derails and dwarf signals; the latter are rendered nearly invisible by the third rail. The derail cannot be done away with as it is an absolute necessity at many points, and should it be over run it will naturally result in a tearing out of the third rail.

In connection with bridge work the third rail will cut many of the floor-beam bracket plates, particularly on through plate-girder bridges, and the further it is located from the gauge line of the track the further into these brackets it will cut. This causes considerable trouble in the design of new structures and necessitates extensive re-modelling in existing structures.

Where cross-overs occur on curves considerable care must be used in order to prevent the contact shoes coming in contact with a running rail in passing from one track to another. The mechanism boxes for switches, derails, torpedo machines, etc., must also be very carefully placed in order to avoid all danger of their being touched by these shoes. These troubles are aggravated by the fact that the shoe is held in position by a spring, and the failure of this spring is liable to let the shoe drop sufficiently to ground on any metal object close to the running rail.

A consideration of the foregoing disadvantages will certainly indicate that the third rail, either over- or under-contact, leaves much to be desired in regard to its assistance in the introduction of electric traction, except on those lines handling special dwarf equipment.



THE FUNCTIONS OF THE ENGINEER AS A SALESMAN

By Sterling H. Bunnell.

The entry of the engineer into the work formerly belonging wholly to the "business man" is the main spring of the movement which within comparatively few years has completely transformed manufacturing. His is the chief influence making it now an applied science—or a systematized application of many sciences. But there is yet in many minds a strong (and often wholesome) disposition to fix a great gulf between professional and commercial work—to shudder at any attempt of the engineer to pass from the mechanical to the business department. Mr. Bunnell shows that these two fields, so far at least as the manufacture of machinery is concerned, must overlap to a wide extent; and in this joint territory the conscientious technical specialist may properly and profitably bring into the sales department many of the functions of the consulting engineer.—THE EDITORS.

ONE of the most successful salesmen of large steam-power machinery, with whom a single contract of a hundred thousand dollars was no uncommon affair, used to say, half in jest, that ignorance was an important part of a salesman's equipment. The statement could hardly be said to be proven by any lack of knowledge on the part of its author, but contained a germ of truth nevertheless. The mistake of many educated and experienced professional men, when attempting to make sales, has been their inability to see an important personal side of the transaction, entirely aside from considerations of good fellowship and social attention. The intending purchaser has his own ideas of the general principles and details of the apparatus which he desires to obtain; and he is not informed as to other details—perhaps misinformed in general. It is the salesman's province to ascertain exactly the requirements of the work to be done, to appreciate and consider carefully the desires of the purchaser, and to supplement his lack of knowledge without slighting and disregarding the value of the information which he has acquired in his business and which has produced the opportunity for the sale.

With the increase in the number of technically educated young men, the former universal doorway by which the higher grades of the profession were entered, via the drafting room, no longer serves to accommodate the crowd. The attractiveness of the selling side of engineering is considerable. For one thing, the young salesman immediately commences to increase his acquaintance with men of attainments in all lines, and his general knowledge of business methods.

The probability of his own financial success is thereby greatly increased. His knowledge of human nature is enlarged, and if he be tactful, agreeable, and (above everything) quick and alert to take advantage of all the bits of information that crowd upon him in his daily intercourse with the business world, he cannot fail to succeed. The most common mistake of the recent technical graduate is a desire to teach the men whom he addresses, instead of a retentive state of mind, prepared to learn of every one. There is so little exact knowledge of practical conditions that one must be wary of attempting to reduce to figures the statements made by men of loose habits of thought, and equally careful neither to doubt openly, nor to accept without qualification, statements of conditions and results which appear to be entirely contrary to scientific principles.

The engineering salesman is frequently called upon to act independently of the consulting engineer. In steam power-plant work for instance, the great majority of the sales consists of plants comprising one, two, or three units each of engines and boilers of less than two-hundred horse power, the cost of such a plant being small, and the conditions of its successful operation being so well-known that the special ability of the high-priced consulting engineer is not appreciated. In such a steam plant, however, there are many accessories which go far toward making the plant a success or failure as they are well or badly designed. The steam piping, if turned over to a working steam fitter to design and construct, is likely to be a serious source of danger; the drainage of condensed water may be poorly provided for, and a considerable quantity of hot water will probably be thrown away instead of going back to the boilers to reduce the coal consumption. The engines may be inconveniently placed; the foundations may be either too weak, or unnecessarily strong and expensive; and in a dozen other ways the best of engines and boilers may form part of a poor outfit. The purchaser of a plant of this character feels able to discriminate between the various propositions made to him, to examine the catalogues, cuts, and specifications submitted, and with the precaution to deal only with builders of reputation, to satisfy himself of obtaining well constructed and satisfactory units. If, now, among the salesmen who address him upon these several propositions, he meets one whose knowledge evidently extends considerably beyond the details of the apparatus he offers, and who is able to make up and submit special sketches and plans showing the plant complete, to make slight improvements in the arrangement to suit conditions which the purchaser has overlooked, to determine the size of acces-

sories and to include them if desired in his estimate of the cost, and to advise as to convenient sources of supply for apparatus which he is not justified in furnishing as part of the contract—this man is nearly sure to carry off the job for his company, even at a considerably higher price than that submitted by others.

Such a salesman has the same advantages over the man without technical ability, when dealing with the most expert consulting engineers. While in this case he is not expected, and in general must not attempt, to make suggestions in regard to changes in details which have been carefully designed with a full knowledge of conditions which the newcomer cannot hope to grasp complete in a cursory view of the situation, his readiness to grasp the desired features of the apparatus, his appreciation of reasons for the specifications of the consulting engineer, and the confidence which his explanations of the details of the construction he offers will inspire, in the mind of the purchaser's engineer, of the undoubted substantial and satisfactory character of the work that will be delivered, will be quite as important as the matter of price in determining the choice among several bidders.

In many other classes of work the chance for the engineering salesman is excellent. In the utilization of waste products, in novel methods of manufacture of well-known articles, in producing new and desirable forms of common materials, and often in arranging details of machinery for already standard processes, no consulting engineer skilled in the particular work in hand can be had, for the reason that the processes or conditions are entirely new. The inventor or promoter of the process is most likely anything but a man of engineering ability; usually he is a practical business man, or a visionary enthusiast, incapable of producing a complete working plant on the lines he has vaguely in mind, and often aware of his inability to do so. The engineering salesman, meeting such a man for the purpose of selling him his power plant or his transmission machinery, or of obtaining the order for constructing his special apparatus, is very likely, if he is awake to the opening presented, to carry off in the end the contract for the complete plant. From his acquaintance with the possibilities of local shops, or of men or corporations of ability in special details of the proposed installation, he is able to collect the necessary data, to make plans and to assemble details, to modify sizes and arrangements, and to supplement the general knowledge of the inventor or promoter with his own special technical ability, so that he can offer the prospective purchaser a well-defined equipment for his

total requirements, covered by a single contract and for a single stipulated price. The purchaser is glad to have but one concern to deal with, and that one which can offer him the services of so skilful an engineer as the man who has assisted him in producing the complete design; while the commission which the salesman secures for his office on the apparatus which he has collected from other parties, and which involves no expense to his office except the collection and transmission of the purchase price, will be a very desirable item of income.

Even after the salesman has obtained his order, his usefulness to his home office is by no means ended. Being familiar with local conditions, he is able to give useful advice as to methods of shipment, points of delivery, local facilities for handling the shipment, and labor skilled and unskilled which may be had on the spot for the purpose of completing the erection of the machinery. In some cases, the salesman, though by no means a workman, can demonstrate the use of machinery and equipment which he has placed, to very great advantage, as he already has the respect and confidence of the purchaser. Being skilled in business affairs, he is able to place local contracts for handling, construction, supplies necessary for erection, and the like, and peculiarly in a position to promote a feeling of goodwill on the part of the purchaser's organization and managing officials. When it comes to a working test demonstrating the capacity or efficiency of the construction, the salesman can undertake the nominal direction of the work, his presence and friendship smoothing many an otherwise rough place in the path of the testing expert, who is generally regarded by the purchaser as more or less of a sharper rather than a scientific investigator. Finally when delivery and test is completed, the engineering salesman, by his ability and his undivided efforts toward the satisfaction of the purchaser with the finished work, has nine out of ten points gained in closing the affair with not only the full payment of the balance due, but a feeling of goodwill which will go very far toward securing the next order for an increase in the capacity of the successful working plant.

THE RAIL HEAD AT RHODESIA BROKEN HILL, CAPE-TO-CAIRO RAILWAY.

RAILWAY PROGRESS IN THE DARK CONTINENT.

By J. Hartley Knight.

The following article carries forward the current summary of African railway construction which Mr. Hartley Knight has presented from time to time in these pages. The significant suggestion for an engineering audience is that where the railway goes, a vigorous demand soon arises for electrical, power, and mining machinery and the whole range of mechanical equipment and supplies.—THE EDITORS.

TWO years have passed since I was permitted in these pages to review the status of railway construction in Africa in an article dealing more particularly with the line between Cape Town and Cairo. During that period railway engineering has made great strides in all parts of the Dark Continent and a vast amount of work in the same direction remains to be attempted in the near future.

At the time at which I wrote, the Cape-to-Cairo railway—which continues to loom large in the popular fancy—was well on the way to its present terminus at Rhodesia Broken Hill, about 2,000 miles north of Cape Town on the coast. This point was successfully reached in the middle of 1906, the first through train arriving at rail head on

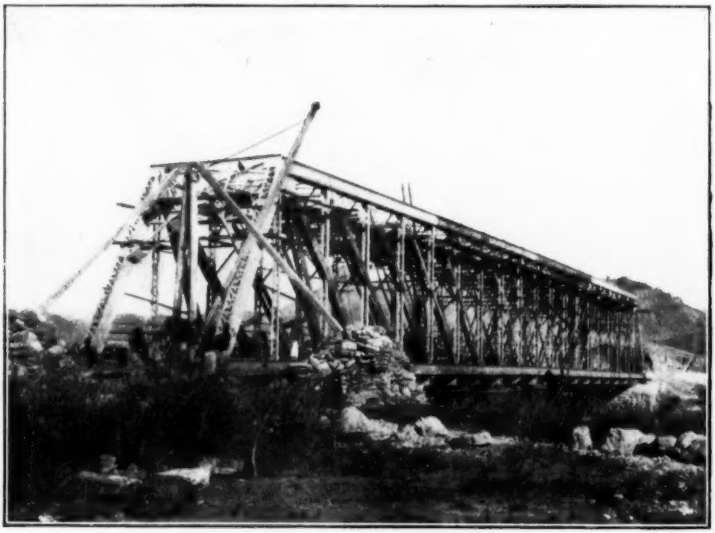
LOOKING THROUGH THE KAFUE RIVER BRIDGE, CAPE-TO-CAIRO RAILWAY.

BRIDGE OVER THE KAFUE RIVER, CAPE-TO-CAIRO RAILWAY.

June 24 of that year, and the line being open for public traffic on September 1 following. Between the Victoria Falls and Rhodesia Broken Hill, a bridge more than a quarter of a mile in length had to be constructed to carry the line across the Kafue River. The bridge in question is the longest (as the bridge at the Victoria Falls is the highest) in Africa, and was put together by means of pontoons in record time, the construction of the line itself—north and south of the Kafue—being proceeded with in the meantime. The gauge of the line, it is worth recalling, is 3 feet 6 inches, and although the track is single there are numerous sidings en route. For the time being the work of construction is at a standstill, the state of the money market not permitting the promoters of the line to proceed; but it is not anticipated that the rail head will remain much longer at Rhodesia Broken Hill. It will be remembered that the late Mr. Alfred Beit, the African magnate, left over five million dollars for the development of the scheme "known as the Cape-to-Cairo railway," and as soon as the gentlemen appointed to act as "railway trustees" under his will come to a decision in regard to the allocation of the money, construction will be immediately proceeded with. Already the next section of the line has been surveyed—to a point on the Congo border known as Bwana M'Kubwa, a little over a hundred miles north of Rhodesia Broken Hill—and all concerned are ready to proceed as soon as they get the word to go, the idea being to carry the line northwards (as foreshadowed in my article of two years ago) until it reaches the Katanga copper fields and thus connects with the line known as the Benguella railway, now being built from Lobito Bay, in Portuguese West Africa, to the aforesaid district of Katanga, some 900 miles in a slightly north-easterly direction. It remains to be seen what is going to be done in regard to carrying the other "fork" of the line up to and alongside Lake Tanganyika in German territory, but I am inclined to think that that route will be abandoned—for some years to come at all events.

Meanwhile, it is gratifying to report that excellent progress is being made in regard to the Benguella railway which, as I need scarcely point out, is likely to have an important bearing on the great Cape-to-Cairo trunk line. The object of the Benguella railway is the development of the reputedly enormously rich mineral area known as Katanga, in the Congo Free State, and, incidentally, the exploitation of other mineral deposits en route. The scheme is that of Mr. Robert Williams, who holds an important concession from the King of the Belgians to work the copper mines; but the leading spirits, so far as

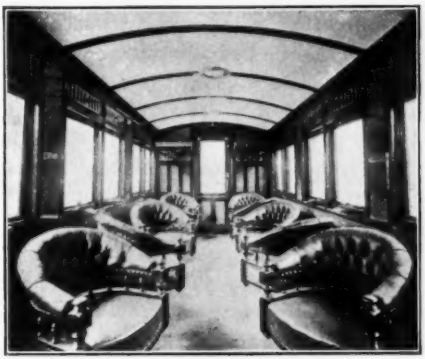
railway construction is concerned, are Mr. J. Norton Griffiths, of the London firm of Griffiths & Co., and Mr. Edward Robins, chief resident engineer at Lobito Bay and local representative of the well-known consulting engineers Sir Dogulas Fox and Partners. Notwithstanding the fact that the railway company is in Portugal, the line is regarded as a British enterprise. At the moment of writing the most difficult portion of the line—that between Lobito Bay and the Katingue plateau, 1,400 metres above the sea—is nearing completion; and when once this is accomplished all will be plain sailing, as the remainder of the track, for upwards of 700 miles, offers absolutely



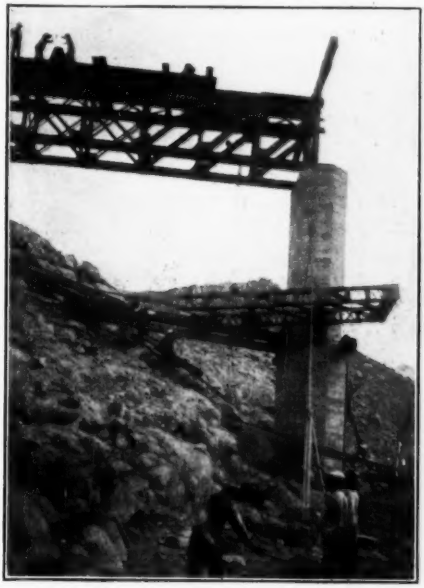
CATUMBELLA BRIDGE, BENGUELLA RAILWAY.

no difficulty from the engineering point of view. Indeed, Mr. Norton Griffiths quite recently assured me that he fully anticipated that when once the summit of the plateau is gained plate-laying will be proceeded with at the rate of a mile a day. Bridges will not be necessary as there are no rivers to be negotiated; and "the nature of the country"—to quote Mr. Griffiths—"is indeed, from now onwards so kindly that really hardly any earthworks are required for the construction of a serviceable line; it is merely a question of laying rails on the flat." The gauge of the line is 3 feet 6 inches; the rails weigh 60 pounds per yard and the steel sleepers 70 pounds each. As has been indicated, the initial part of the undertaking has been anything but a

picnic to those chiefly concerned. The spanning of the various ravines which cross the ascent to the Lengue Gorge, for example, entailed some fine engineering work, the railway hereabouts having a gradient of 1 in 16. No. 1 viaduct consists of five equal spans of 18 metres on a gradient of 1 in 20·75; No. 2 viaduct is made in three spans and is built on a gradient of 1 in 16·5; whilst No. 3 viaduct has four 18-metre spans, built on curve of 150-metres radius. Owing to the rapid rise in the levels of the country the contractors decided to make use of the Riggenbach rack system, as extensively used in Switzerland, the length of which is about two kilometres. The gradient is about 1 in 16 and the sharpest curve 100-metres radius. At time of writing some 8,000 men (including 1,500 Indian coolies imported from Natal) are employed on the line; and as showing the progress made it may be mentioned that during the twelve months ended last June, 300,000 cubic yards of material were excavated, largely consisting of decomposed granite.



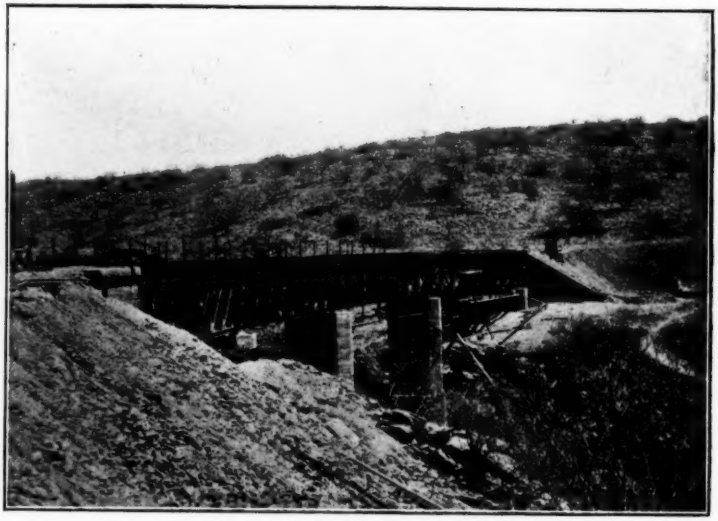
TYPE OF SALOON CARRIAGE, BENGUELLA RAILWAY.



ST. PEDRO BRIDGE AT THE TOP OF LENGUE GORGE, BENGUELLA RAILWAY.

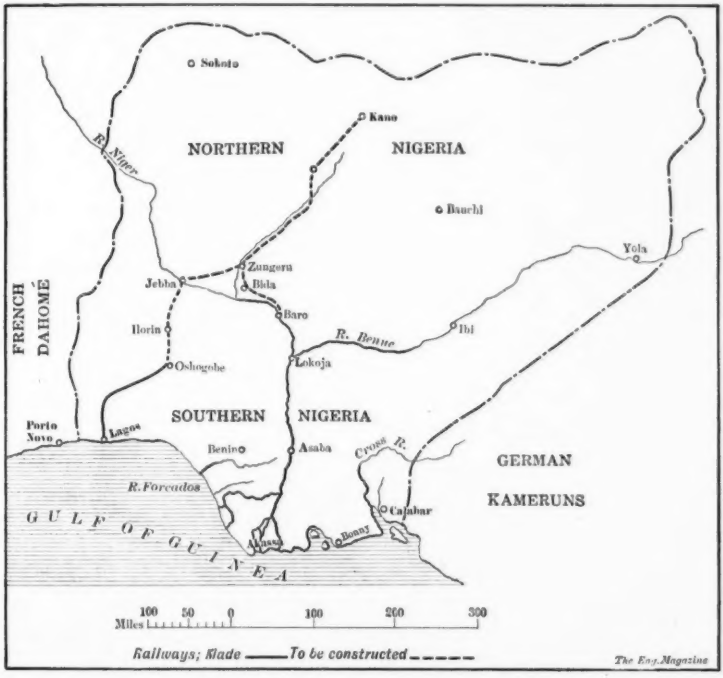
Before leaving West Africa one may be permitted to glance at railway progress, present and prospective, in the British

colony of Nigeria. In August last it was announced in the House of Commons that it had been decided to authorize the immediate construction of a pioneer railway, of 3 feet 6 inches gauge and 400 miles long, from Baro, the highest convenient point on the perennially navigable reaches of the Niger, to Zungeru *via* Bida, and thence in a north-easterly direction to Zaria and Kano. Ultimately the line will connect at Zungeru with that commencing at the coast port of Lagos, and as it will tap the huge cotton district its importance to commerce can hardly be over-estimated. It is anticipated that the line will take four years to build, the supervision being in the hands of the well-known Canadian engineer Sir Percy Girouard, who has had considerable experience in railway engineering in Egypt and the Soudan. On latest advices work on the new railway is now in active progress, the rails for the first 20 miles of line having already been landed from England, and over 2,000 workmen being engaged on the earthworks. The section now under construction is the first portion of the new system and is 120 miles in length, running from the Niger northwards towards Zaria, the point of the important junction to the Banchi highlands and Lake Chad. It is expected that Zaria will be reached within 18 months; and during next summer another section of 150 miles of rail will be delivered on the Niger. Sometime during 1909 railway communication will be established between the coast



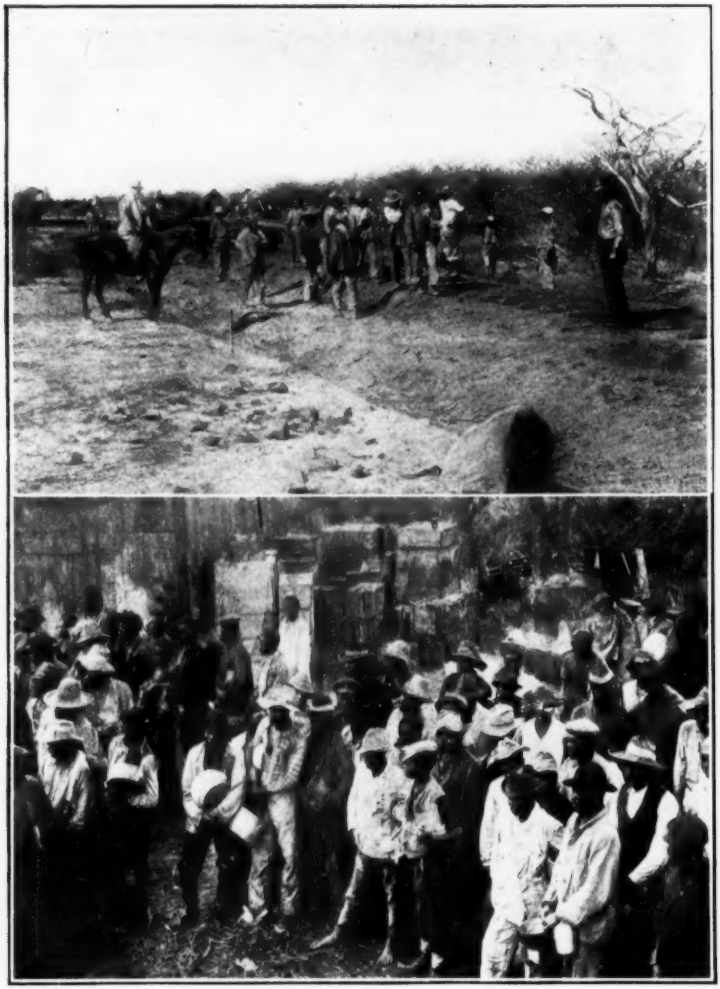
LENGUE VIADUCT, BENGUELLA RAILWAY.

and Zaria from Lagos—a distance of 700 miles—Kano itself being reached in 1910. The railway from Lagos is now being carried to Ilorin which place it is expected in June 1908, a total distance of 250 miles.



SKETCH MAP OF THE NIGERIA RAILWAY.

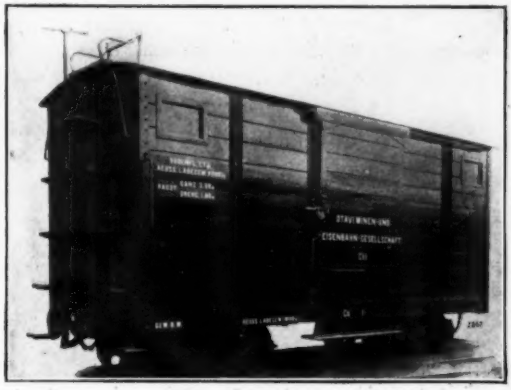
Coming further south, but still on the western side of Africa, must be chronicled the completion of the light railway running from the coast port of Swakopmund, in German West Africa, to the copper district of Tsumeb, known as the Otavi railway. The work was planned and carried out by Messrs. Arthur Koppel, of London and Berlin. The railway, which runs for 350 miles, is the longest 2-foot gauge line in the world. Construction was commenced in November, 1903, but was greatly retarded owing to the outbreak of the Herero rebellion. Seven months later the contractors engaged a number of Italian workmen and things went well for a time, but the big strikes then prevailing in Italy affected the workers on the Otavi line and construction was again seriously interrupted. Scarcity of water,



TRACK LAYERS AT WORK, AND A GROUP OF NATIVE WORKMEN WAITING FOR RATIONS, OTAVI RAILWAY.

which had to be carried on ox waggons a distance of 30 or 40 miles, was also a drawback and, boring experiments failing, special water trains had to be run up from Swakopmund. Then the natural features of the country traversed by the line were unfavourable to rapid

construction, a height of 3,600 feet having to be climbed in a distance of only 68 miles, at the same time keeping within the maximum gradient of 15 in 1,000. I understand that the rails used on the Otavi line weigh 30 pounds per yard and are fastened to steel sleepers throughout; the trucks have a capacity of 10 tons of 1,000 kilos, and are of the double-bogie type. The locomotives are of 120 and 150 horse-power capacity, the speed varying between 9 miles and 15½ miles per hour. In its course the line passes over one hundred steel bridges of 5½ to 22 yards span.



"COVERED GOODS WAGON," OTAVI RAILWAY.

Another light railway, the partial completion of which is already proving a factor of considerable importance in the development of the Dark Continent, is that known as the Western Oases railway, which will link up the once prosperous, but more latterly, much neglected, rich green patches in the Libyan desert. Take a map of Egypt, and some 300-odd miles south of Cairo and on the Nile you will see a place called Farshut. That is the starting point of the Western Oases Railway. It may interest the curious to know that the concession for the line is for a period of 70 years; that the Egyptian Government has given a provisional guarantee of interest and the concessionaires, the Corporation of Western Egypt, possess for 20 years a monopoly of railway construction between any of the four western oases and the valley of the Nile, and "within or between" any of these four oases. From Farshut the course runs in a south-westerly direction to a place called Meteng, then turns and drops, almost due south, to Kharga. A detailed survey of the first section of the course was made early in 1906, by Messrs. Kincaird, Waller, Manville & Dawson, consulting engineers, whose report, a very favourable one, showed that the only engineering difficulty to be encountered en route was that presented by the steepness of the descent

into Kharga. The engineers were convinced, however, that the line could be laid here, using no worse a gradient than 1 in 25—a gradient which, although steep, is not, I believe, without precedent in narrow-gauge railway construction. As a matter of fact the worst gradient has been improved from 1 in 25 to 1 in 40, as a result of which the freight capacity of a train will be doubled. The question of gauge was, for a time, something of a stumbling block, but eventually, on the recommendation of the consulting engineers, it was decided to adopt the standard narrow gauge used on the Delta Railway and other Egyptian lines, namely, .75 metres (equal to 2 feet 5½ inches). This determined, the work of construction was rapidly proceeded with, the Corporation acting as their own contractors. The line, which connects with the Egyptian State Railway at a point near Farshut on

ON THE WESTERN OASES RAILWAY. A TRAIN OF CAMELS HAULING RAILWAY MATERIAL, AND A BIT OF SUB-GRADE FORMATION ON THE LIBYAN DESERT.

THE WELL AT BERES, KHARGA OASIS, WESTERN OASES RAILWAY.

the Nile, has been carried across a tract known as the Cultivation and up the Wady Sahmoud onto the plateau (the Libyan Desert) and at time of writing the first section of the line is rapidly approaching completion. All the formation work has been finished on the scarp (a long descent into the oasis) to the terminus at Kharga town. The full length of the track is 194 kilometres. The weight of the steel rails used is 36 pounds per lineal yard, these rails being laid on creosoted timber sleepers in the Nile valley and in the oasis, and on steel sleepers across the desert. The railway is being laid as a single line, sidings to enable trains to pass being provided for the present at intervals of about ten miles. Base buildings have already been erected and headquarters established on the edge of the desert; telephone equipment being completely laid to railhead. The headquarters of the railway, I am advised, will shortly be fixed at Kharga instead of as at present at Qara, at the Nile valley end. The transport of material and machinery by pack camel from Farshut to the Kharga oasis was an interesting business. A depot was established at El Der, some 110 miles from Farshut and 20 miles to the north-east of Kharga village, where are the remains of a Roman fortress. While the greater portion of the material was transported by pack camel, certain heavy details such as boilers, drill frames, etc., had necessarily to be transported on wheels by means of draft camels. In order to expedite

matters 30 special camels were purchased and trained, while the rougher portions of the desert track were improved as far as possible and a good zig-zag road cut on the cliff descent from the desert plateau into the oasis. The operations in question will, it is anticipated, do not a little in the repeopling of the large area comprised in the concessions, and render the communities dwelling therein not as at present merely self-sustaining, but capable of a large production of commodities suitable for exchange with those of western Europe.

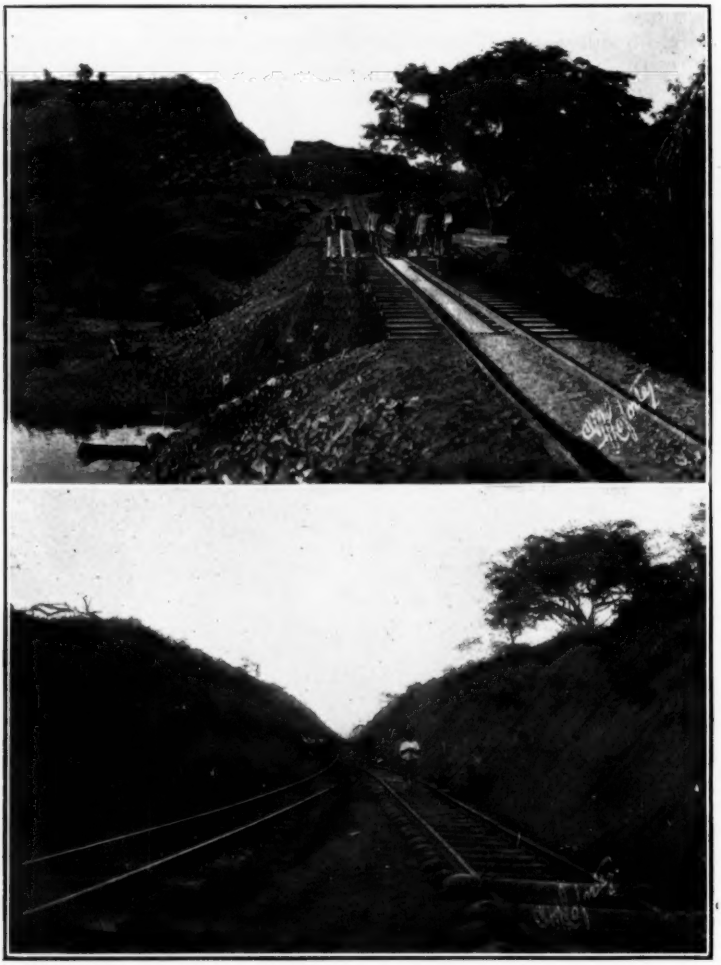
CLEANING A LOCOMOTIVE ON THE WESTERN OASES RAILWAY.

In the space at my command it is possible to refer only briefly to the progress which has lately been made in railway engineering in other parts of Africa than those already indicated. Thus slow but steady progress has to be reported in connection with the railways of the Congo Free State, and trains now run regularly between Stanleyville and Ponthierville in less than 5½ hours, including stoppages. In Abyssinia, the line has reached Harar, but all hope of its extension must apparently be abandoned—for the time being at any rate—owing to the existing political deadlock. The locomotives on this line, by-the-bye, are built to carry 13 tons of water, which enables them to run one hundred kilometres without the necessity of stopping for rewatering. In British Central Africa railhead has now reached Mile 62½, and it is confidently expected that Blantyre will be gained at the end of the present year. The section of the line between Chiromo and Port Herald has been in constant use and has greatly

expedited and facilitated trade generally. In French Africa a good deal of activity prevails and the iron horse is advancing in the Ivory Coast, in Dahomey and elsewhere; and preparations for railway construction in Algeria on a somewhat extensive scale are in contemplation. Progress has at last to be chronicled in regard to the Mrogoro railway in German East Africa, Colonial Secretary Dernburg, during his recent official tour in those parts, being enabled to travel over the line from Dar-es-Salam to Mrogoro, the inland terminus. The contractors for the line are Messrs. Phillippe Holzmann & Co. In another part of German Africa, on the western side of the continent, a section of the new Lüderitz Bay railway, about 30 kilometres in length, was lately opened for military transport.

A VIADUCT ON THE ABYSSINIAN RAILWAY.

Coming, in conclusion, to the sub-continent, quite a number of branch and other lines there have been or are being constructed. Inter-communication with the several British colonies there is rapidly becoming more general, and the network of lines running in all directions south of the Zambesi is slowly but surely increasing. Not the least important of these is the line which is being built by the Portuguese from Lourenço Marques to the border of Swaziland, which is British territory, through which country it will eventually be extended to the Transvaal—presumably to the existing rail-head at



ON THE SWAZILAND RAILWAY. WORK ON THE UMBELOZI RIVER, AND A CUT AT MATOLLA.

Ermelo. The line when completed will form an alternative route from Delagoa Bay to the great gold fields of the Rand, and will mean a saving of eight or nine hours on the journey between the points mentioned. The line, which has been described by a competent authority as "a model of engineering skill" will run through Mbabaan.

the new capital of Swaziland, and past Lake Christie, thus effecting a saving of 60 miles on the route. It is a matter for regret that the Transvaal authorities, for some occult reason, do not show any particular enthusiasm for the Swaziland railway, as it is called, nor display any great desire to push on with the "linking up." They appear to be more in favour of spending a large sum of money in reducing the curves and gradients on the existing line between Pretoria and Lourenço Marques. Swaziland—as the "party" most affected—avers that this if carried out would be the falsest of false economy. And I am not so sure that Swaziland is very far out in her reckoning. The connection is surely bound to come, sooner or later, and there is hardly any doubt that the scheme, when completed, will be of immense benefit to Lourenço Marques as well as to Swaziland—the well-named "Cinderella" of the many States in the great sub-continent.

DJIBOUTI STATION ON THE ABYSSINIAN RAILWAY.

CAN RAILROAD COLLISIONS BE REDUCED TO A THEORETICAL MINIMUM?

By Harold Vinton Coes.

"The only way by which the disregard of signals and rules can be prevented is by making it physically impossible. The engineer must have no discretion as to whether he will stop or run past a block signal; he must be stopped by a mechanical device the release of which is beyond his control." That this statement in the editorial columns of THE ENGINEERING MAGAZINE for December, 1904, can be repeated after a lapse of three years with added emphasis is amply proved by the evidence given by Mr. Coes of the increasing number of railway collisions and corresponding sacrifice of human lives. Mr. Coes maintains that if railway officials still refuse to equip their locomotives with such mechanical safety devices, the value of which has been proved on the express tracks of the New York Subway, it can only be because they lack the most ordinary humanitarian sentiments and not from motives of economy.—THE EDITORS.

IN this article, one phase of railroad accidents only is dealt with, viz., collisions, as it is into this class especially that the author has been examining. From the engineer's standpoint this type of accident is particularly interesting as it affords him many complex problems to study, the satisfactory solution of which would be of great benefit to mankind.

When one analyzes the reports of the Interstate Commerce Commission and the Statistics of Railroads, he is astonished by the appalling showing of figures and tables—statements of facts which cannot be denied. If he is of a questioning turn of mind or interested in the subject from a humane standpoint, he naturally asks himself how much of this is true, how much due to the rapid growth of the great railroad systems, and how can this seemingly unnecessary slaughter and maiming be reduced to a theoretical minimum?

Mr. Carroll W. Doten, of the Massachusetts Institute of Technology, in his admirable paper entitled "Recent Railway Accidents in the United States," read before the American Statistical Association, shows in Table I, next page, that the increase in casualties from collisions for the whole country between 1895 and 1903 was 270 per cent. He says, "By comparing this table with the following one in which density of traffic is measured in train-miles per mile of line, it will be seen that the amount of traffic does not afford an explanation of this increased liability to collisions. An increase of 305 per cent between 1898 and 1903 is observed in Group II where traffic is densest and 300 per cent in Group X where traffic is least dense.

TABLE I. PASSENGERS AND EMPLOYEES.

Casualties per Million Train-Miles—Collisions.

Group Year.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	U. S.
1891...	2.5	3.4	3.0	4.3	6.8	2.3	3.0	2.8	3.3	5.0	3.4
1892...	3.0	4.0	2.6	5.0	5.9	2.5	1.9	2.4	2.4	2.3	3.3
1893...	4.1	4.3	2.5	1.6	4.1	2.0	1.5	1.9	2.4	2.7	3.1
1894...	1.6	3.0	3.6	2.6	3.1	2.1	0.6	1.2	2.2	2.1	3.2
1895...	1.5	2.6	1.7	2.0	2.6	1.2	1.2	1.6	4.0	3.4	2.0
1896...	1.3	2.2	1.6	4.1	6.3	1.1	1.1	2.1	3.6	2.3	2.2
1897...	1.4	2.0	1.8	2.7	3.7	2.0	2.0	2.2	3.2	2.8	2.2
1898...	2.6	2.0	2.5	2.9	3.0	1.4	2.2	3.5	2.3	2.7	2.3
1899...	4.0	3.3	2.6	3.6	3.4	1.4	3.7	2.0	3.3	4.5	3.1
1900...	3.3	3.6	3.8	7.0	6.9	2.3	5.0	2.4	3.5	3.5	3.6
1901...	1.4	6.6	3.7	6.4	6.6	2.3	4.7	3.1	5.0	4.5	4.4
1902...	3.7	8.1	6.5	8.4	6.7	4.5	6.0	4.3	7.6	8.0	6.1
1903...	3.4	8.1	9.2	15.0	7.9	5.1	8.4	9.7	6.5	9.8	7.4

TABLE II. DENSITY OF TRAFFIC IN THOUSANDS OF TRAIN-MILES PER MILE OF LINE.

Group	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	U. S.	U. K.	Can.
1891..	7.3	9.9	6.1	3.3	3.6	3.9	2.8	3.1	2.0	3.0	3.6	16.0	3.1
1892..	7.7	10.7	6.3	3.2	3.8	4.3	2.8	3.1	2.9	2.9	3.7	16.1	3.0
1893..	8.1	10.6	6.5	3.3	3.6	4.3	2.9	3.5	2.9	2.9	3.8	15.6	2.9
1894..	7.5	9.5	5.8	3.1	3.2	3.8	2.5	3.0	2.8	2.6	3.4	15.9	2.8
1895..	7.0	9.5	5.7	3.2	3.2	3.4	2.3	2.8	2.8	2.5	3.3	16.0	2.5
1896..	7.3	9.8	5.8	3.4	3.2	3.4	2.2	2.9	2.8	2.6	3.4	16.6	2.7
1897..	7.1	9.6	5.4	3.4	3.3	3.7	2.2	2.9	3.0	2.4	3.3	17.2	2.7
1898..	7.2	10.0	5.6	3.3	3.5	4.0	2.4	3.3	3.0	2.5	3.4	17.5	3.0
1899..	7.2	9.8	5.8	3.3	3.6	4.0	2.9	3.2	3.0	2.7	3.4	18.2	2.9
1900..	7.3	9.4	5.9	3.3	3.4	3.9	2.4	3.1	2.7	2.4	3.4	18.4	3.0
1901..	6.9	9.3	6.0	3.2	3.6	3.9	2.6	3.2	2.8	2.6	3.4	18.1	2.9
1902..	7.1	9.3	6.1	3.3	3.7	4.0	2.6	3.3	2.9	2.8	3.4	18.0	3.0
1903..	7.4	9.3	6.2	3.4	3.8	4.1	2.9	3.2	2.8	2.9	3.5	18.6	3.2

NOTE.—The groups here referred to are those ten geographical divisions of the United States, which the Interstate Commerce Commission has adopted for statistical purposes. This divides the railroads according to the territory through which they run, and takes into account density of population, topography of the country, and the character of the industries served by the railways.

Official figures for the year ending June 30, 1905, show that 196 passengers were killed and 3,336 were injured in railway collisions. The same authority gives the total number of passengers carried as 738,834,667. Hence one was killed in every 3,769,819 and one injured in every 221,443, by collision accidents alone. The total of passengers killed during the same year by railway accidents of every class was 537; the number killed in collision (196) was therefore 36.5 per cent of the whole. In the year ending June 30, 1906, 418 passengers were killed in railway accidents of all classes, 120 of these being by collisions; the loss of life in collisions during this year was thus 28.7 per cent of the whole. The table at the top of page 635 covers these same periods, but includes all persons killed or injured—employees, trespassers, etc., as well as passengers.

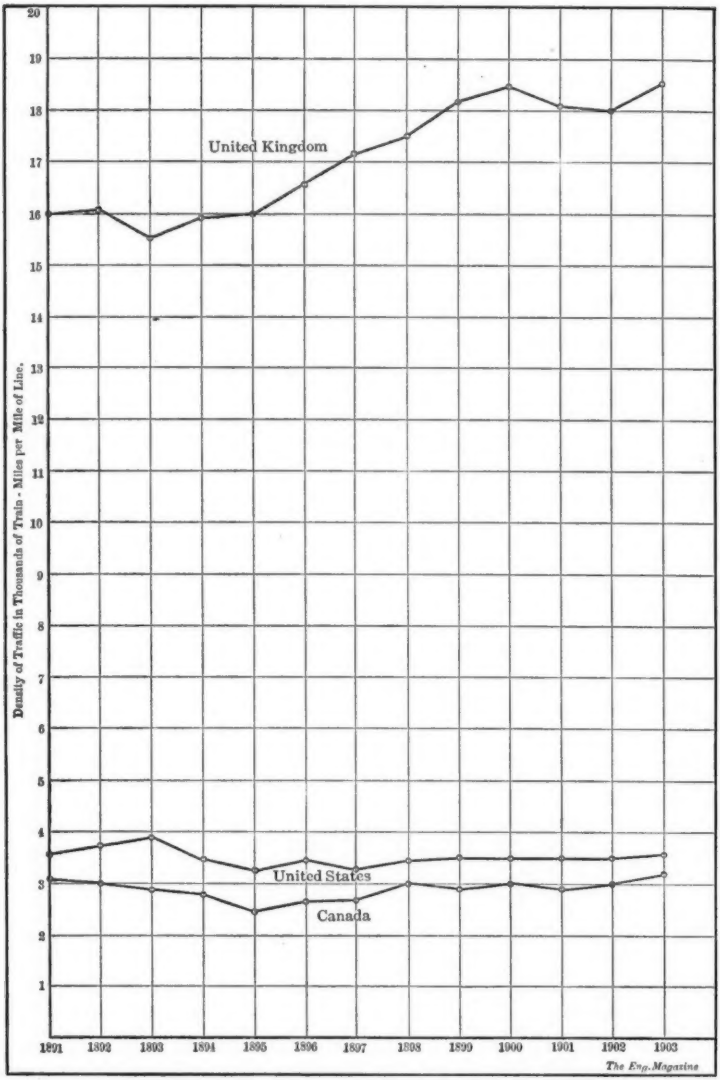


CHART I. SHOWING DENSITY OF TRAFFIC PER MILE OF LINE IN THE UNITED KINGDOM, UNITED STATES AND CANADA, 1891-1903.

TABLE III. COLLISIONS, DAMAGES TO CARS, ENGINES AND ROADWAY.
Authority of Interstate Commerce Commission.

	Year Ending 1906—June 30.				Year Ending 1905—June 30.			
	Number.	Loss.	Persons Killed.	Persons Injured.	Number.	Loss.	Persons Killed.	Persons Injured.
Collisions, rear	1,722	$1,720,365	169	2,427	1,493	1,463,012	152	2,085
" butting	866	1,599,568	251	2,733	707	1,451,906	304	2,453
" trains separated	901	359,156	9	375	972	440,495	11	369
Collisions, miscellaneous	3,705	1,640,669	175	2,379	3,052	1,493,641	141	2,204
Total	7,194	$5,319,758	604	7,914	6,224	4,849,054	608	7,111

Recently two accidents due to collisions were reported on railways in the eastern United States. The first was on October 1, at Providence, R. I., on the N. Y., N. H. & H. R. R. The Knickerbocker Limited was run into by the Shore Line Express and three persons were seriously injured. The former train was one of the crack extra-fare trains on the road, and yet it was not exempt. The second wreck was on the Worcester, Nashua and Portland division of the Boston & Maine R. R. Eight people were injured in this accident. The collision was due, it was reported, to a thick cloud of smoke obscuring the signal. This is only an instance of what takes place every few days, and even kills railroad presidents, as in the case of Samuel Spencer on the Southern R. R. What can we do to stop this? How can we safeguard human life, and at the same time get our trains over the road on time? There is no question but that the railroad companies have all they can do to meet the increased demands on their traffic facilities. How can we reduce the collision rate? Who are to blame? The engineers, or the signalmen, or the system? These are questions that are on every railroad official's tongue and are interesting very many of the thinking public at the present time.

Mr. Doten in his comments on the table given above as Table II says: "This table has a certain significance on its own account. It shows how much denser railway traffic is in the United Kingdom than in the United States and Canada. 18,600 train-miles per mile of line means that on the average 51 trains pass over each mile of line in the United Kingdom every twenty-four hours, Sundays included. It also shows that the density of traffic in the United States measured in this way has not been increasing, but has rather fallen off since the early nineties. (See Chart I.) This signifies that the growth

of traffic measured in train-miles and passenger-miles, has been distributed over longer lines and bunched in heavier trains, which would seem to indicate that the train-despatcher's duties are no greater than before. But whether the fault is with the brain that issues the orders, or in the one that receives and executes them, does not matter so long as the results are the same."

Let us now investigate the block-signal system and see if that throws any light on our previous figures.

Block signals may be classified in three ways:—*

1. Depending upon the manner in which their day indications are shown.
2. Depending upon the manner in which they are controlled and operated.
3. Depending upon what they control.

In the first classification there are:—

I. Banner signals, whose indications are displayed by a revolving banner.

II. Disc signals, whose indications are displayed by a movable disc in front of a fixed background, and

III. Semaphore signals, whose indications are displayed by the positions of an arm moving in a plane at right angles to the track. In all types under one class the night indications are displayed by colored lights.

In the second classification there are:—

I. Manual, the signal being controlled and operated by man power.

II. Controlled manual, the signal being operated manually and constructed so as to require the co-operation of the signalman at both ends of the block.

III. Automatic, the signal being operated by power which is controlled entirely by the presence or absence of a train in the block, or by the condition of the track.

An absolute block system is one which never allows more than one train in the same block at the same time.

A permissive block system is one which may allow more than one train in the same block at the same time, provided the trains are moving in the same direction and the second train has been warned by signal that another train is in the block.

The signals must not only warn the engine driver that there is a train in the adjacent block, but they must be so spaced as to give him

* This classification is due to Mr. W. G. Foster and appeared in the *Electric Journal* for July, 1907.

room enough to bring his train to a stop, before entering the block. It is when this principle is overlooked that a collision occurs.

Blocks vary in length from 4,000 to 12,000 feet. It is difficult to arrange the signals so as to obtain uniform spacing and at the same time place them where the engineer can obtain an unobstructed view of them on approach. The minimum length of block depends upon the distance in which the train at maximum speed can be stopped. Hence if the signal is placed so as to give a good view, but at the same time is spaced back in order to do this (so that the length of the block is equal to or less than the minimum) then the above principle is violated and the block is dangerous.

While riding on a locomotive on one of the eastern American roads using signals of the banner type, I noticed that the signal flashed to danger when the train was about 150 feet away from it. This peculiarity or defect caused a serious wreck on the road a little later, the engineer thinking that his train had set the signal while in reality it had been set by a local freight on the cross-over just beyond.

The non-automatic or manually controlled signal is usually operated from block towers or cabins, each tower controlling a certain section or sections, the signals repeating themselves either on a dummy board or by sode signals. This is well providing the signal man sets the right signals and has not been worked too many hours; or the engineer is not dead, sick, color-blind, or wilfully runs by the signal. In other words, the element of the individual enters into this system and in fact the system depends upon this element for its successful operation.

The automatic block signal is at present a permissive system, for if a signal is out of order it assumes the stop position, as it is constructed to do; so that traffic may not be entirely suspended for several hours. This type of signal depends upon a track circuit for its operation. Certain rail joints at the end of each section are insulated from each other by removing the fish plate and inserting one of the many non-metallic track bonds now in use, the intermediate rails being bonded together, so as to complete the circuit by a No. 8 galvanized-iron wire. A battery is then connected across the rails at one end and an electro-magnet or relay across the other, as shown on the next page.

The pivoted armature falls away from the relay by gravity and must be energized to hold it up. The wheels of the train bridge the track as at "a-b" and thus complete the circuit through the engine and rails cutting out the relay, which drops its armature, thereby operating the

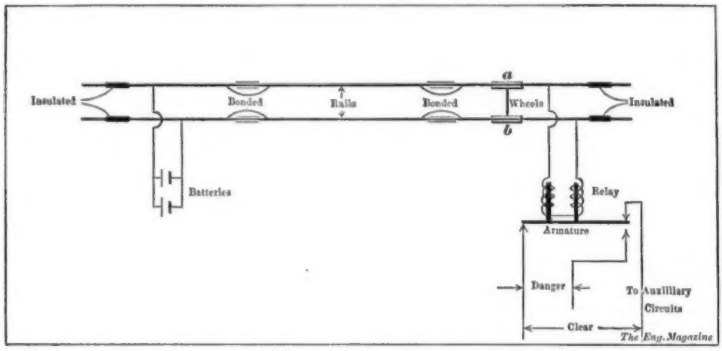


DIAGRAM OF OPERATION, AUTOMATIC BLOCK SIGNAL.

auxiliary circuits which control the signal and thus set it to danger. Hence it is readily seen that a broken rail will ordinarily interrupt the circuit, thereby demagnetizing the relay and consequently setting the signal to danger. The automatic block, therefore, serves three purposes; it warns an engineer that there is a train occupying the block ahead of him, or that there is a defective rail, or that the signal apparatus is out of order. If the signal does not set to clear within a reasonable length of time, the engineer then knows that one or the other of the last two conditions is causing its non-operation, or that the train ahead has broken down. But if the engineer does not obey this warning, or if he is dead, sick, asleep from overwork, or color-blind (this latter ailment applying particularly at night when colored lamps are used) or if the signal is obscured by fog or smoke and he runs past the place where he thinks it ought to be and enters the block ahead—then all the effectiveness of the automatic block-signal system is lost, and we again have to depend upon the human element as to whether the signal does its work or not. The last paragraph may be summed up by the statement that no signal on its own account ever stopped a train.

It is, therefore, plain that all of the present signal systems depend upon fallible human nature for their operation, or at least for their correct interpretation, and hence that collisions can and do occur with appalling frequency on all roads using signal systems of any kind. This may be seen from Chart II. A perusal of the records shows that these catastrophes are not due as a rule to the signal systems themselves, but are directly traceable to any one of the human fallibilities mentioned above.

In other words, we must extend our automatic block-signal system one step farther and make it absolute; we must eliminate the dangerous personal elements; we must take the control of the locomotive out of the hands of the engineer and make it impossible under normal conditions for him to run past a block. As an instance to illustrate this point, recently on the Erie Railroad an engine of the camel-back type, (i. e. using a Wooten firebox and thus separating the engineer from the fireman) lost its engineer by an accidental blow on the head, and if it had not been that the fireman noticed that the train was running past a station, a disastrous collision might have occurred. So great is this danger on this type of locomotive that the legislatures of

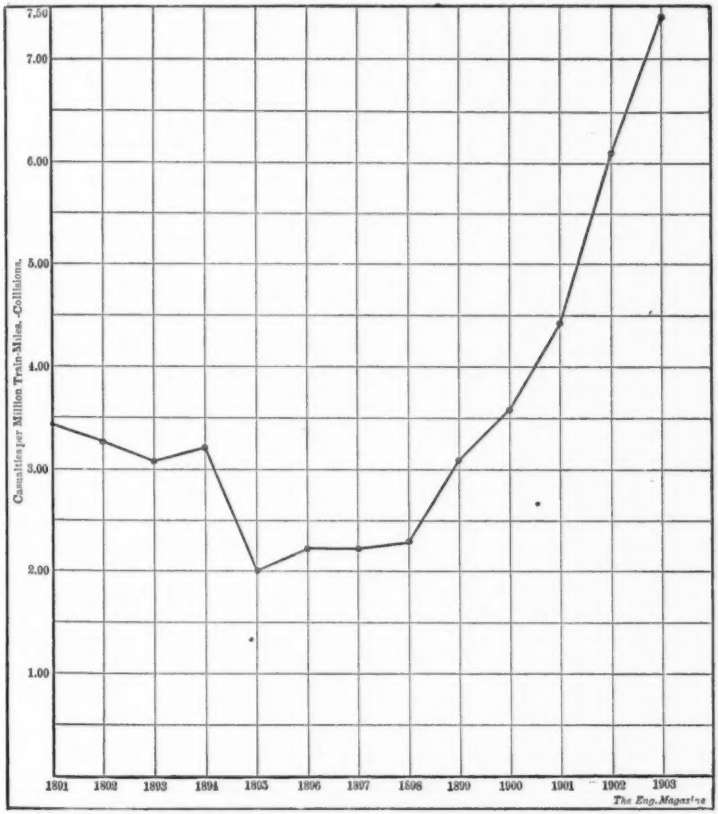


CHART II. SHOWING CASUALTIES PER MILLION TRAIN-MILES DUE TO COLLISIONS IN THE UNITED STATES, 1891-1903.

one or two of the States are advocating carrying an additional man in the cab. However, any operating official knows how little room there is in one of these cabs for an extra man, and the inadvisability of carrying one.

The conservative traffic and operating official will say that this is too radical a step, that "if a block system is made absolute it will be impossible to get trains through on time." This reasoning however is

AN ANALYSIS OF 14 RAILROAD COLLISIONS OCCURRING DURING THE MONTHS OF JANUARY, FEBRUARY AND MARCH, 1907.

Class of Collision.	Kind of Train.	Killed.	Injured.	Damage to Engines Cars and Roadway.	Cause.
Rear End	F & F	2	2	$5,250	Engineman ran past two automatic block signals set against him.*
Butting	P & P	4	107	7,745	Regular east bound passenger train ran past meeting point.
Miscel.	P & P	0	6	9,567	Misplaced switch at station. Target of switch covered with snow.*
Rear End	P & P	1	15	10,100	Approached station (8 P. M.) not under control; faulty flagging.
Rear End	F & F	2	5	11,000	Excessive speed, and failure of standing train to flag.
Rear End	F & P	0	11	11,025	False clear block (manual controlled block, communication from cabin to cabin by bell code, mistake in bells).*
Butting	F & F	0	3	11,100	Eastbound ran past signal at meeting point at 4 m. p. h.*
Butting	P & F	0	11	11,170	Westbound passenger train disregarded wait order.
Rear End	P & F	0	16	12,000	Passenger train unexpectedly stopped (3 A. M.); run into at rear by freight.
Miscel.	P & F	5	3	12,400	Extra freight entered main track in face of fast train disregarding automatic indicator at switch.
Butting	F & F	1	3	15,933	Northbound train disregarded meeting order. The order read "meet engine 567." At the meeting point engine 565 was on the side track and this was taken for 567. N. bound passed full speed.
Miscel.	P & F	0	3	21,900	Passenger train disregarded distant and home automatic block signals; ran into side of freight train. Fireman had called clear signals to engineman without seeing signals.*
Butting	P & F	9	8	48,500	Passenger train ran past block signal, and freight disregarded time limit.*
Butting	P & F	2	12	11,300	Westbound extra freight (2 A. M.) neglected to head in at entrance to side track; engineman asleep.
Total	14	26	205	198,990	

Accidents marked with * bear directly on the subject.

false, for the engineer, knowing that, even if he cannot see the signals, his train will be brought to a stop if the signal is set to danger, will be able to keep his train up to speed between blocks, instead of crawling along and feeling for the signal. Again the official will say: "The engineer will get to depending too much upon this device and will, therefore, relax his vigilance." This can readily be taken care of by making the automatic stop self-recording, so that the superintendent will know at the end of the day's run just how many times the train has been stopped by this method.

The most powerful argument that the railroad companies will use against this step is the cost of equipping the roads with such a system. Let us inquire into this. The Twentieth Annual Report of the Interstate Commerce Commission for the year ending June 30, 1906, shows that the cost to the railroad companies of collisions, excluding damages to property and indemnities paid to or on account of persons killed or injured, was $10,659,189, and if there were any method of obtaining the figures for the damages and indemnities, it would swell the figure to many millions more. Is not this worth saving? Why spend hundreds of thousands of dollars in trying to secure further economies in the rolling stock, while there is this big leak at the other end?

The above mentioned report also states that there were in operation in the United States up to June 30, 1905, 48,357 locomotives. These, excepting 947, were classified as: passenger 11,618; freight 27,869, and switching, 7,923. Deducting the 7,923 and the 947 from the sum total we have 39,487 locomotives in effective operation for long-distance runs. A conservative estimate shows that the cost of equipping a locomotive with a device absolute in its operation including the track connections and connections to signal would be $1,000. Hence the total cost of equipping the locomotives of all the roads would be $39,487,000. Assuming that the new system would save, if it were at all efficient, 50 per cent of the $10,000,000 paid out last year for collisions, and taking the cost of the system in round numbers at $40,000,000, the device would pay for itself (exclusive of the amount saved on the damage and indemnity bill) in eight years, or pay 25 per cent on the original investment, the maintenance being charged off on the amount saved on the damage and indemnity bill.

Let us assume another point of view and examine the income figures of the railroads and see if they can stand the expense, apart from the above figures. The total income of the railroads, covered by the Twentieth Annual Report of the Interstate Commerce Commission,

was $920,221,859. Against this amount was charged for interest, rents, betterments, taxes, and operating and miscellaneous expenses, the sum of $590,386,554, and as dividends the sum of $229,406,598, leaving a surplus for the year of $100,428,707. From these figures it looks as though the railroads could well afford to safeguard human life more closely in the matter of collisions.

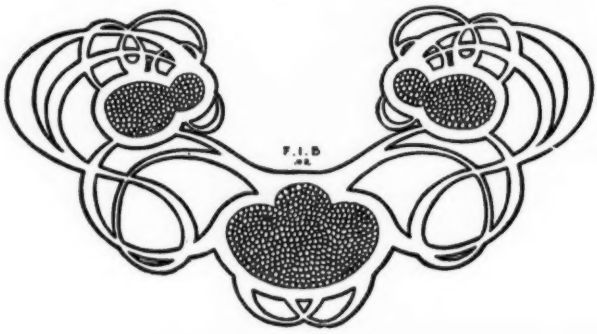
In general, then, the following conclusions may be safely stated:

That with our present signal systems collisions seem to be on the increase, as may be seen from Chart I, and that apparently the railroads are unable to cut the rate down to its approximate theoretical minimum.

That all systems depend upon the human element for their successful operation or at least interpretation, and that as man is fallible he must be superseded by tireless and infallible automatic machinery.

That some system of automatic stops should be used in connection with our present signal systems, so constructed as to perform the same functions as the engineer, viz, to shut off the power and to apply the brakes, at the same time retaining the air in the auxiliary reservoirs after the brakes have been applied, so that traffic will not be delayed by waiting for the train line to build up to normal pressure; and that the connections from the signal system to the trips on the locomotive be so mechanically constructed as to operate successfully in ice or snow storms, or whenever the signal system is in operation.

That the public should guard its interests in this respect, if the railroads do not see fit to do so, by appealing to the proper source, namely, Congress, and have such laws passed as will attain the desired results, as was done in the case of the air brake, the automatic coupler, the block-signal system, and the car-heating system.



MINING DEVELOPMENTS IN NEVADA.

By A. Selwyn-Brown.

The review following covers the conditions up to the end of 1907 and is guided by the author's intimate personal knowledge of the districts. It is especially interesting in view of the present prominence of the Nevada mining regions in the public eye. Mr. Selwyn-Brown's references to individual properties, we need hardly emphasize, contemplate physical conditions only—not financial conditions. He is concerned with ore values alone, without favor and without prejudice to share values. A similar study of the Nevada copper regions will follow next month.—THE EDITORS.

THE great Tonopah gold mine was discovered on one of the prominent mesas, or barren mountains which are so numerous in the desert areas in Nevada and Arizona, in May, 1900. Nevada at that time was just beginning to awaken from the deep economic lethargy into which she was plunged after the flooding of the Comstock mines in the early eighties, and the closing down of nearly every mine of importance on the other mining fields through the fall in the value of silver. Although gold was discovered and mined in many places in the State in the early days, Nevada was generally looked upon as a purely silver producing State, in consequence of the extraordinary richness of the silver mines on the Comstock, Eureka, Candelaria, Austin, Pioche, and other famous fields. It was, however, a difficult matter for the discoverers of the Tonopah mine to finance it. The investing public was skeptical when told of rich gold discoveries in a remote part of the desert region in the south-eastern portion of Nevada. Had the mine not carried rich shipping ore from the grass roots down, the mining history of Nevada today would not be so interesting as it is. The mine, to a large extent, paid for its own development. Early in 1902 Philadelphia capitalists, led by J. W. Brock, purchased a controlling interest in it at a high figure, and at once set about the building of the Tonopah railroad. A steady rush of prospectors then set in which resulted in the rapid development, during the years 1904-7, of important gold mines in many other localities. During 1905, and until the early part of the present year, the wonderful reports of the rich finds and yields of some of the gold mines in these new camps attracted world-wide attention, and resulted in the investment of a large amount of capital. This influx of outside capital greatly stimulated prosperity in the

mining camps, particularly in Goldfield, Bullfrog, and Manhattan, and led to extensive share-dealing operations not only in local centers, but on the San Francisco, Philadelphia, New York, and other stock exchanges, with the consequent rapid soaring of share values. Dollar shares like those of the Tonopah, Tonopah Extension, Goldfield Consolidated, Shoshone Consolidated, and other mining companies advanced in some instances above $18. The general monetary stringency commenced to extend to Nevada, however, in August. In November the local banks suspended payments and a general slump in share values set in, with the result, that business on the stock markets is at present practically at a standstill. This unhealthy financial situation is accompanied by a train of other economic ills, including the closing down of many mines and construction works, the reduction of wages, and restriction of general business affairs. Labor troubles and a serious increase in crimes of violence are beginning to add to the State's embarrassment. With such conditions prevailing, there need be little wonder that some of the less reflective people interested in the State's progress opine that Nevada is again entering a period of economic quiescence like that following the Comstock boom. My own experience and investigations on the principal mining fields do not induce me to view the present disordered conditions in Nevada pessimistically.

Topography.

A large portion of southern Nevada has an elevation above sea level varying between 2,000 and 6,000 feet. The elevation of the Tonopah and Goldfield districts is between 5,000 and 6,000 feet. These districts are traversed, as is indeed the whole State, by innumerable mountain ranges and peaks with intervening valleys trending, generally, in a south-westerly direction toward the Sierra Nevada. The mountains, as a rule, do not rise much more than 400 or 500 feet above the level of the valleys, but in places some prominent peaks of great elevation are met with. In the Toyabe and Toquima ranges north of Tonopah there are several peaks covered with perpetual snow. The mountains are, generally, gently undulating; but in places, owing to changes in rock formations and other causes, the ranges are formed of numerous sharp peaks and ridges which the prospector finds dangerous, or impossible, to climb and prospect. Most of the ranges and valleys are bare of timber; but in places, the high peaks and the ravines running down their sides are covered with stunted pine trees which are known to miners by the Mexican name of *piñon*. The only vegetation in the mineral districts is the dreary, strong-smelling sagebrush, which is able to thrive in the dryest

deserts, and is of inestimable value to miners by serving as food for their trusty burros, and, when wood is not procurable, as fuel.

Water is scarce throughout the mining districts. In places small streams running down the gulches from snow-capped mountain peaks yield supplies of drinking water to many neighboring camps. Some mining centers are dependent upon the scanty supply of some mountain or desert spring. Such springs, however, are numerous, and prospectors rarely go more than 15 or 20 miles before meeting with one. As mining camps develop and capital becomes available, ample water supplies for all purposes are obtainable by tapping the great underground rivers below the desert valleys by means of artesian wells. Almost every valley in the State in the vicinity of the snow-capped mountains carries artesian water streams. At Tonopah, Goldfield, and Bullfrog, artesian water is now being employed in the large milling and cyanide plants.

Geology.

Nevada is a huge tableland supported by the Sierra Nevada and outliers of the Rockies. As these great mountain chains have risen, the intervening rock formations have been squeezed and faulted, and extraordinary volcanic phenomena have been forced into activity. Evidence of volcanic action is everywhere visible in Nevada, and thermal springs, even today, are playing important parts in bringing about geological changes. Volcanic rocks must be common in such a region. They cover very large areas in the State, and constitute the most important formations in the mining districts. Granitic rocks occur to a less extent, and are not so important to the miner as the volcanic rhyolites, andesites, and porphyries. In some localities, as Reveille, lead and copper lodes occur in limestones and other sedimentary rocks. Coal and mineral oil deposits are also found in some of the sedimentary areas.

Minerals.

The whole of Nevada is mineralized. There is hardly a settlement in the State which does not possess a mineral deposit of some kind. In addition to gold, silver, copper, and lead, deposits of sulphur, zinc, bismuth, antimony, tungsten, nickel, iron, mercury, arsenic, salt, borax, and other minerals are being developed. In many districts valuable deposits of many kinds of gem-stones also occur, the most important being turquoise and opal. Sapphires, garnets, and diamonds have been found in the gold wash in several places.

Mineral Statistics.

Mining statistics have never been accurately compiled in Nevada and today there is a noticeable variance between even the smelting

companies' returns and the Government bullion-tax statistics. The mineral production of the State can only be estimated approximately. The Goldfield mines from January 1, to November 23, this year, shipped 112,081 tons of ore valued at $11,208,100. The miners' strike is likely to interfere with the output for a few weeks, but it is safe to estimate that the production this year will be at least a third as large again as that in 1906. A conservative estimate is 127,000 tons of ore, for a return of $12,700,000. The returns from Tonopah will be somewhat less owing to the mines on that field being worked in a more conservative manner than those at Goldfield, which are to a great extent operated by a large number of lessees working small leases. The Tonopah mines this year will yield 200,000 tons of ore valued at $10,000,000. The smaller fields will return about 100,000 tons of gold ore valued at $4,000,000. The gold and silver yield of Nevada in 1907 will consequently amount to about 427,000 tons of ore valued at $26,700,000. In nearly all Nevada ores the ratio of silver to gold is about two to one. It is necessary to bear this in mind when reading of the returns from the gold mines, which are usually given in dollars per ton, and these figures include both the gold and silver contents of the ore.

The following table, which has been carefully compiled from the most reliable statistics available and rather understates the real production, will give a good idea of the distribution of mineral wealth in Nevada. The production of other metals than gold and silver, is not included.

GOLD AND SILVER PRODUCTION IN NEVADA, 1850-1907.

District.	*Mineral.*	*Returns.*
Comstock	Silver, gold	$640,000,000
Eureka	Silver, lead, gold	90,000,000
Pioche	Silver, gold	40,000,000
White Pine	Silver	25,000,000
De Lamar	Gold	15,000,000
Austin	Silver	60,000,000
Belmont	Silver	10,000,000
Tybo	Silver	6,000,000
Tuscarora	Silver, gold	25,000,000
Candelaria	Silver	18,000,000
Aurora	Gold	13,000,000
Pine Grove	Gold	5,000,000
Jefferson	Silver, gold, lead	3,000,000
Cortez	Silver	3,000,000
Silver Peak	Gold, silver	3,000,000
Reveille	Silver	2,500,000
Silver Star	Gold, copper	1,250,000
Tonopah	Silver, gold	29,000,000
Goldfield	Gold	26,700,000
Newer Fields	Gold and silver	5,000,000
Total		$1,033,350,000

To this enormous value of $1,033,350,000, yielded by the gold and silver mines of Nevada since the Comstock rush in 1850 to the end of 1907, must be added the value of the large quantities of copper, lead, iron, zinc, and other metallic ores and of the sulphur, borax, salt and other minerals mined. This would bring the grand total of the mineral production of Nevada to date to about $1,400,000,000. This is a splendid showing when the comparatively small amount of capital that has been invested in the development of the State is kept in view. It bears eloquent testimony to the fact that mining investments in Nevada, on the average, have been unusually successful.

TONOPAH.

The mining area comprised in the Tonopah goldfield is about seven miles square. Mining operations have proved the whole of this area to be mineralized, and it is quite probable that future mining operations will show that the Tonopah vein systems extend to, and form part of, those now being successfully worked on Lone Mountain, which is situated 17 miles west of Tonopah, and at Ray, 12 miles north of Tonopah. The principal development work to date has been done on the first discovered mines, namely, the Tonopah, Montana, Midway, Belmont, North Star, and Tonopah Extension mines.

In parts of the Tonopah field there are no less than six formations overlying the lower ore-bearing formations. As a consequence of this, prospecting work must be carried on under the supervision of geological experts. The correct placing of mining shafts that must be sunk several thousand feet before crosscutting for a vein is undertaken through hard volcanic rock formations, requires the exercise of a high order of scientific acumen. Hitherto, very few mistakes have been made in the planning of mining work, and there are few important fields in any country that can show such successful results as Tonopah. The results here attained are due, probably, as much to the conservative business methods of the directors of the mining companies operating on the field as to the skill of the engineers in charge of the mines. But for the backing received from the directors, the bold work carried on in some of the mines might not have been brought to a successful issue.

The first successful mine developed at Tonopah was the Tonopah mine on which the first discovery of mineral in the district was made by a Californian prospector named Butler, in May, 1900. The vein in this property outcropped for a short distance on the surface, and carried ore sufficiently rich to bear all the expenses of shipping to the smelters in California and Utah. This mine is now developed to a depth of 1,000 feet, and lateral developments underground exceed

five miles in length. The value of the ore at present blocked out for stoping is estimated at $20,000,000. A milling plant has recently been erected by the company at a cost of $400,000 at Millers' Siding, a small railroad center situated some 12 miles west of Tonopah. This plant is now treating about 2,000 tons of the company's ore weekly.

The next mine of importance to strike gold was the Montana, which lies at the eastern boundary of the Tonopah leases. The vein was covered by several hundred feet of rhyolite, a volcanic formation of great extent in Nevada. The bearings of the Tonopah vein being accurately taken, a shaft was located and sunk at a point calculated to be on the line of strike of the vein eastward. Results showed the accuracy of the work. This has developed into a property, second only to the great Tonopah mine. It is shipping 1,000 tons of ore to the mills weekly.

Strikes were afterwards made in the Jim Butler, Midway, West End, Belmont, North Star, California, and other properties. The West End mine has been developed to a depth of 500 feet. It has a vein over 60 feet in width which yields ore of both milling and shipping grade. The Jim Butler mine has been developed to the same depth as the West End. It has a strong ore-bearing vein over 6 feet in width. In addition to large reserves of milling ore awaiting treatment, this mine is shipping about 150 tons of high-grade ore to the smelters weekly.

An extension of the Tonopah vein has been met with in the low ground west of the Tonopah mine in the McNamara and Tonopah Extension mines, which are situated about a mile away from the Tonopah mine. Further west, the Ohio, McKane, Red Rock, Great Western, Home, Little Tonopah, and Golden Anchor mines are sinking to catch the extensions of one or more of the veins now being successfully worked in the developed mines. None of these mines has been developed to sufficient depth yet. The McNamara and Extension have shipped a large amount of ore, but the others have not got into the ore-bearing formations.

The western extensions of the veins have been struck in the Boston, North, Star, Belmont, Rescue, and other mines. The Belmont and North Star are already in the shipping class and have large ore reserves opened up.

The Indiana, California, Crown Point, and other properties are operating on the southern portion of the field on cross veins; and there is a tendency for miners to prospect to a large extent on the northern part of the field.

Tonopah, as was intimated above, is not a poor man's field. Owing to the heavy covering of the ore-bearing andesite formations by several hundred feet of rhyolite and other volcanic rocks, which are expensive to sink shafts through, the field can only be developed with the aid of capital. The work already done has proved the value and extent of the field. The veins are large, regularly formed, and productive, and, at depth, are uniformly rich. The district has a healthy climate and there are no hindrances to mining developments. Electric power for the mills is obtainable from generating stations utilizing the hydraulic power of the streams in the Sierra Nevada, and several sources of water for domestic and mining purposes have been developed close to the town. The mining population is about 7,000.

In the vicinity of Tonopah a number of important mining centers are being developed. Hannapah, Bellehelen, Reveille, Golden Arrow, Clifford, and Silver Bow are promising gold centers eastward of Tonopah. The Manhattan field, situated about 20 miles north of Tonopah, is the most important northern camp. About 50 promising mines are under development here. Several mines are shipping high-grade ore. Recently two small milling plants were erected at Manhattan and they are now operating on milling ore from the principal mines. Atwood, Orizaba, Golden, Midas, Wonder and Fairview are other important northern camps.

Silver Peak, Blair and Candelaria are the important mining centers west of Tonopah. Valuable mines are in course of development in each camp.

GOLDFIELD.

Gold was accidentally discovered at a watering place in the desert about 20 miles south of Tonopah in 1903. Some rich returns were obtained by the early prospectors and the field has been extensively developed with most satisfactory results. In 1905, gold to the value of $3,500,000 was obtained from nine of the principal mines. Last year the production amounted to about $10,000,000, and this year it promises to amount to not less than 127,000 tons of ore valued at $12,700,000. More than eighty important mines are in course of development at Goldfield. Many of the mines have been developed by lessees and the fortunate ones have rapidly acquired large fortunes. Speculation in shares assumed large proportions until temporarily checked by the financial stringency in November. The following table gives the ore yield of the field for each month during 1907, and the total stock sales on the Goldfield stock exchange for the corresponding periods. The figures to November 23 are official, for the balance of the year they are estimated.

ORE OUTPUT AND STOCK SALES DURING 1907.

Period Ending.	Tons Shipped.	Stock Sales.
Jan. 26	8,440	$3,311,563
Feb. 23	4,989	2,480,070
Mar. 30	2,323	3,959,415
Apr. 27	512	4,381,119
May 25	4,283	2,567,821
June 29	11,193	1,586,340
July 27	14,687	1,590,312
Aug. 31	17,724	1,772,549
Sept. 28	14,393	1,180,187
Oct. 26	20,237	728,325
Nov. 23	11,470	104,866
Dec. 31	9,000	1,500,000
Total	119,251	$25,162,567

In addition to this Goldfield stocks are actively traded in to a very large extent on the San Francisco, Tonopah, Reno, Chicago, New York, Boston, Philadelphia and other stock exchanges.

BULLFROG.

The Bullfrog goldfield is situated on a direct line about eighty miles south-west of Tonopah. During the past three years several important mines have been developed. The rhyolite which is connected with the gold deposits at Goldfield and Tonopah extends south to Bullfrog, and is the prevailing formation covering the surface over a large area of the district. The topographical characteristics of the district are in most respects similar to those of the more celebrated northern goldfields.

The most valuable mining property at present developed is the Shoshone Consolidated, situated on Montgomery Mountain. This mine has been developed to a depth of more than 600 feet, and opened up with many miles of tunnels and other lateral works. Seven distinct ore-bearing veins have been cut, traced and developed.

Among other important mines on the field the Tramps Consolidated, National Bank, Gibraltar, Mayflower, Gold Bar, Keane Wonder, and Gold Center are prominent. Gold occurs in these mines, as at Tonopah and Goldfield, in regular, well-defined quartz veins, and in irregular bonanzas formed in the rhyolite by mineralized volcanic waters permeating and depositing their contents in the creviced zones in the rocks, which had been shattered by seismic disturbances and the intrusion of volcanic dikes.

Numerous smaller gold-mining centers are being opened up in the vicinity of Bullfrog. The most promising of these are Johnnie, Indian Camp, Monte Cristo, Gold Crater, Kawich, Gold Mountain, Cuprite, Montezuma, Lida, and Palmetto.

Western Fields.

Throughout the state a great number of mining camps are being developed more or less successfully. On the main railroad west of Tonopah, gold, silver, and copper deposits of great extent are being opened up in the vicinity of Sodaville. Further north, prospectors are busy developing mining leases recently granted on the old Indian reservation on the western shore of Walker Lake. Some rich gold and copper finds are being made in that locality. At Yerington, further north, in Lyon County, a number of developing mines promise to become steady producers. The Douglas, Wilson, Mohawk, Ludwig and Bluestone are among the leading properties.

There is also a large amount of mining work being carried on in the vicinity of Virginia City. An extensive pumping plant has been erected on the Ward shaft by several of the Comstock companies which have amalgamated with the view of unwatering the deep workings in the old Comstock mines. There are immense low-grade ore bodies in all these mines that can now be profitably mined. A new gold rush recently set in to the Ramsey district which is situated about twenty miles northeast of Virginia City. Gold is being mined in several of the claims and there is every promise of a permanent camp.

Northern Fields.

Much less attention has been given by prospectors to the northern districts in Nevada, but development work on a small scale is being carried on at Olinghouse, a gold camp north of Winnemucca. The old silver camps at Austin, Eureka, Bullion, Tenabo, Mineral Hill and Cortez are being reopened by large Utah smelting companies.

Eastern Fields.

During the past three years a number of Colorado and Utah mining men have prospected a large area in White Pine and Lincoln Counties which adjoin the Utah State line. Many successful discoveries have been made. The most important, probably, is the discovery of immense copper deposits in several of the old silver mines at Ely.

From this review, the healthy condition of Nevada mining will be clearly apparent, and it will be easily understood how this State ranking very low as a gold producer a few years ago, has since 1905 forged ahead in gold mining so as to rival Alaska closely in its annual gold yield, and promises within the next two or three years to assume the position Colorado has held for some years as the greatest gold State in the Union. Nevada is not now dependent upon one great mining center and one mineral product as it was in the Comstock days. There is consequently, little likelihood of the present financial stringency seriously arresting its great mining developments.

EDITORIAL COMMENT

Have Courage and Common Sense!

IN our December issue we spoke of the present business disturbance as a "psychological panic"—a trouble due to a state of mind which mental courage and common sense would be certain to dispel. In a sense this is true of every period of depression. But the peculiar difference is that while usually a panic collapse in business results from the realization of conditions long existent and grown cumulative in their effect, the crisis now is caused by the *failure* to realize conditions of soundness that make depression unreasonable and its long continuance impossible.

As Mr. Del Mar points out in his article leading this issue, we have in our hands one-third of the entire gold stock of the world—more than France, England and Germany combined. Instead of the slender stock of gold with which we faced the panic of 1893, we hold secure in our Treasury a thousand millions. Instead of the outflow of sixty-six millions which characterized that period, we have had within two months an influx of nearly a hundred millions, and the golden stream is still pouring into our ports. More gold—new gold—is coming from the mines of the world at the rate of more than a million dollars a day, one-quarter of it from our own States and territories. There is no slightest shadow of menace to the money standard—that great cause of all panics—but in place of it we have currency all "as good as gold," and in ample volume. Our per capita circulation is, in fact, now larger than ever before in the history of the Nation. Our banks are strong beyond peradventure. And our stores of crops and staples—of natural products which the peoples of the other Continents must have—make us creditor to all the world, and insure prosperity for every transportation, manufacturing, and commercial interest, in the profitable work of gathering them and getting them to market.

Such faults of overtrading and overspeculating as we have committed have been liquidated and expiated. Unsound schemes and unsound financiering have been wiped out. The projects and the methods of plungers and promoters of watered stocks have been widely and deeply discredited. They cannot, for years to come, command either credit or capital for such speculation in stocks as precipitated the present unsettled conditions of business. We are on sure foundations, with fundamental wealth in such profusion as the world has never heretofore known, with technical skill and industrial capacity and system which have been the envy of the nations—and nothing lacking but co-operative determination, to carry forward our manufactures and our commerce with unparalleled prosperity. There is coming need in modern civilization for everything we can make and carry and sell. Time lost now—productive capacity unemployed—are lost forever. It is a time for steady speed ahead, for persistently seeking and if need be *commanding* business—not for faint-hearted pause and frightened retrenchment. The years ahead are golden—even more golden than those recently passed. "Speak to the people that they go forward!"

The Ashokan Dam "Scandal."

THE so-called "investigation" of the contract for building the Ashokan Dam has now developed a situation which demands the immediate and watchful scrutiny of the entire press, and all the commercial, civic, and taxpayers' associations of Greater New York.

The building of this great dam is the first and most important step towards the construction of the greatest water-supply system that has ever yet been undertaken anywhere. The aggregate cost of the entire work will be somewhere between $160,000,000 and $250,000,000, and of course many years of time will be required for its completion. Because of the magnitude of the undertaking, and especially because of the absolute necessity for keeping partisan politics and "political grafters" out of the work, the Legislature of New York publicly pledged Mayor McClellan to the appointment of three Commissioners of the Board of Water Supply to be selected and nominated by the three leading commercial organizations of Greater New York. In accordance with this obligatory public pledge, the Mayor was fortunate enough, for the city, to secure the services of Mr. J. Edward Simmons, nominated by The Chamber of Commerce, of which he is President, Mr. Charles N. Chadwick, nominated by The Manufacturers' Association of New York, and Mr. Charles A. Shaw, nominated by The Board of Fire Underwriters. These are all men of the highest probity of character, of spotless integrity, distinguished by long and successful business careers, and throughout the recent and scandalous newspaper campaign of insinuation, ridicule, and misrepresentation, not even the boldest of the political intriguers back of this so-called "investigation" has dared to give utterance to a suspicion of the straightforward and open honesty of the Commissioners in the matter of letting this contract.

In explanation of their action, on the first day of the so-called "investigation," the Commissioners presented a dignified and exact statement of all the essential facts and circumstances leading up to the letting of the contract. A careful reading of this statement, followed by close study of the official documents and all the evidence that has since been brought out by the Commissioners of Accounts, serves to satisfy us that the Commissioners of the Board of Water Supply not only acted conscientiously, but also with orderly procedure and deliberation, and manifestly with the greatest care to see that the best interests of the city might be served. And in coming to a conclusion, they not only had, in formal written opinions, the high warrant of the very best engineering advice that they could command, but they also had an exhaustive written opinion from the Corporation Counsel, proving that, legally and technically, they would be obeying the manifest purpose of the State Legislature in letting the work to the contractor who, in their best judgment, could best serve the city's interests.

These important official documents are all in available typewritten form for those who may desire to read them; and the signed statement of the three Commissioners, above referred to, has been wisely issued *in printed form*, so that it may be obtained at once, by either personal or written application to the Secretary of the Board, No. 299 Broadway, New York. We strongly commend a reading of this printed document by every one who may be in any way concerned, because it failed of publication in the newspapers, and in this issue we have not available space for repeating the essential facts embodied in the statement.

The point of immediate importance is, that the so-called "investigation" has not developed one essential fact which is contrary to, or in conflict with, the perfectly frank and open statements which the Commissioners of the Board of Water Supply have made, filed, and held open for public inspection, from the very beginning of the transaction. On the other hand, the conduct of the inquiry, from beginning to end, indicates a settled purpose to discredit the Commissioners before the

public, and if possible through newspaper notoriety, misrepresentation and ridicule, to drive them out of office, and thus open the way for the Mayor to secure the appointment of commissioners who will manage the great work as he personally may desire—which is the direct opposite of the known purpose of the law creating the Board of Water Supply!

In view of these developments, we are highly gratified to observe that at least three of the most influential of the New York newspapers have already sounded a note of warning. Thus, in an admirable editorial review of the facts of the case, published in its issue of December 7, *The Evening Post* concludes as follows:

"So far as the inquiry itself is concerned, it is regrettable that it has been accompanied by an unusual crop of rumors that politics and a partisan endeavor to control the whole $160,000,000 expenditure are behind it all; and that the decision is to be filed at once, if it has not already been written. So far-reaching a question can only be settled after full deliberation. This we must believe to be the intention of the investigators. Since a partisan inquiry would be little less than a crime, it is regrettable, too, that the Commissioners of Accounts have declined to allow the Water Commissioners to cross-examine the former's experts or to submit their statements for examination."

In like manner, *The New York Tribune* in its issue of December 10 says:

"The members of the Board of Water Supply were specifically authorized by law to select not the lowest bid, but that which they considered the best bid; and they did it. They were carefully selected for their places with a view to their exercising their discretion and judgment for the city's welfare; and they did it. They were expressly directed to 'select the bid or proposal the acceptance of which will, *in their judgment*, best secure the efficient performance of the work'; and they did it, with the reinforcement of their own judgment by the deliberate and expert judgment of the best technical authorities at their command. That the propriety of their action should be called into question, save on the basis of something more than has appeared in the course of the investigation, must be regarded as strange, disappointing and discouraging."

And in its issue of December 14, *The Outlook* concludes a careful review of the facts in this wise:

"It is right that the expenditure of millions of the city's money should be safeguarded; but that expenditure already has the protection of a Board of Water Supply, chosen upon the advice of civic associations, and the protection of expert engineers. Only the evidence of fraud or gross neglect should be allowed to distract the energies of these public servants from their work. Such evidence has not yet been forthcoming. What most needs to be investigated is the real cause for this investigation."

The Engineering Index.

THE attention of the users of THE ENGINEERING INDEX is called to several changes, beginning with this number, which we hope will add greatly to the value of the Index by making the information concerning the literature of any subject more complete and more easily available. In Mechanical Engineering, the items referring to the design of machines and machine parts, as distinguished from operation or manufacture, have been placed under the new sub-head "Machine Elements and Design"; while items referring to conveying and handling machinery are now gathered in a new sub-section headed "Transporting and Conveying." In the Mining and Metallurgy section, new subheads are provided for, "Lead and Zinc" and "Minor Minerals," and for "Ore-Dressing and Concentration." Minor improvements are the inauguration of a more elaborate system of cross-references than has been possible hitherto, and a typographical scheme by which it is hoped the cross-references will be made fully self-explanatory.

REVIEW OF
THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

HEAVY RAIL SECTIONS IN AMERICA.

AN IMPARTIAL VIEW OF THE CONTROVERSY BETWEEN THE STEEL MAKERS AND THE RAILROADS REGARDING STEEL RAIL SPECIFICATIONS.

Engineering.

SOME months ago a review in these columns discussed the steel rail situation in the United States and outlined possible improvements in the processes of manufacture. The subject is growing in importance daily and the following impartial comments on the controversy between the buyers and makers of rails, taken from a recent editorial discussion in *Engineering*, will be read with great interest.

A certain number of rail failures is always to be expected, but the figures published by the railway systems and derived from other sources show that the failures of rails in service are out of all proportion to the duty demanded of them. Taking the statistics published by the Railway Commissioners of the State of New York, it is found that whereas the failures in that State during the first three months of 1905 numbered 1,331, during the corresponding period in 1907 they numbered 3,014; in other words, there was one failure for every seven miles of track in 1905, and one for every three miles in 1907. This increase is coincident with the rapid substitution of 100-pound rails for the lighter sections and the statistics show that the heavy section rails are responsible for more than their due share of failures. Another interesting fact is disclosed when the failures are classified according to age, namely, that the figures for the material rolled in the years 1904-7 shows a much higher number of failures than that rolled during earlier years. There seems to be no doubt, taking the most lenient view of the case, that, whether the question of the section, or the quality of recent product of the rail mills compared with that of former years is considered, the number of failures has lately been inordinately large. The question of who is to blame is the present cause of controversy, the rail makers blaming the section and the railroads blaming the processes of manufacture.

"Commencing with the question of chemical composition, the point which will at once strike anyone familiar with English practice is the high percentage of phosphorus allowed in American rails. It was round this point that the discussion centred on the occasion of the reading of Mr. A. L. Colby's paper on 'American and Foreign Rail Specifications,' at the London joint meeting, in 1906, of the Iron and Steel Institute and the American Institute of Mining Engineers. Mr. Colby advanced the plea that, in order to allow America to compete for European rail orders, the specifications on this side of the Atlantic should be so relaxed that the higher phosphorus rails rolled in America would be accepted over here. Although doubtless such a move would be a most practical way of proving the existence of good feeling between the Old and the New World, none of the authorities over here seemed disposed to accept the invitation. The British standard rail calls for the following composition:—Carbon, 0.35 to 0.5 per cent.; manganese, 0.7 to 1 per cent.; silicon, not to exceed 0.1 per cent.; phosphorus, not to

exceed 0.075 per cent.; and sulphur, not to exceed 0.08 per cent. The limits in American practice, as given by Mr. Colby, vary with the weight of section. Phosphorus is not to exceed 0.1 per cent.; silica not to exceed 0.2 per cent.; while carbon varies between the limits of 0.35 and 0.60 per cent.; and manganese, 0.70 to 1.10 per cent., both according to section, the larger quantities being for the heavier rails. These limits are quoted from manufacturers' standard specifications, and, to quote Mr. Colby verbatim: 'To obtain steel rails with a guaranteed phosphorus content lower than 0.10 per cent. is now impracticable from the majority of American rail-makers.' While even then comparatively troublesome, the situation has of late become still more acute, until the railroads have made a definite stand against high-phosphorus rails. It is stated that, owing to the enormous requirements of the last few years, American mills have scarcely been able to supply demands, and, since 1901, have practically refused to be bound by specifications, or to give guarantees of service, as were once given; the most they will concede now being the replacement of defective rails. The rail-manufacturers for a time had the whip-hand, and for the greater part the railways have had to put up with what has been given them. Lately, however, owing to the railroads withholding orders until assured that they would get what they wanted, the manufacturers have been attempting to justify their attitude. They claim that good Bessemer low-phosphorus ores in the American continent are becoming worked out. The natural retort is that the process must be suited to the ores obtainable, instead of the railroads being forced to accept rails of a quality endangering the lives of passengers. This is a view which the steel firms have up to recently refused to consider. Apparently the safety of the traveling public does not concern them. If, the railroads claim, the Bessemer process will not give rails with lower phosphorus than 0.1 per cent. with the ores obtainable, the open-hearth basic process must be employed. At present, however, the United States is largely a Bessemer country. In 1905 nearly 12½ million tons of Bessemer and low-phosphorus pig were produced in the United States, compared with just over 4 million tons of basic pig. The total production of rails in 1905 amounted to 3,375,929 tons, of which all but 183,264 tons were by the Bessemer process. The manufacturers are not at present in a position to supply open-hearth rails if any large demand be made for them, and a certain amount of time must elapse before they can possibly do so. At the present time there are only a few mills which can supply open-hearth rails, but new open-hearth basic plants are being erected, and others are contemplating conversion from Bessemer to the open-hearth process. It is satisfactory to find that the steel-makers are at last moving in this direction, but it must be admitted that they are not accepting the situation very gracefully. This, after all, is only human, for they must expend a good deal of capital in the process of conversion, which in the end will only benefit the railways; whereas if they had been able to continue to foist successfully on the railroads high-phosphorus rails, the work would practically have resulted altogether in returns on present capital alone.

"The next point of consideration is that of piping, the failures in a large number of cases being due to small pipes, which develop under heavy traffic. In this connection the manufacturers claim that they cut off as much crop as is necessary to get down to sound material. It appears that of recent years the amount cropped off has often only been 10 per cent., whereas it is largely held that from 20 to 30 per cent. must be discarded to get down to good steel. The buyers assert that the manufacturers now discard less, with the purely commercial object of increasing the output of their mills. When it is considered that piping and segregation occur to such a marked degree in steel ingots, and that phosphorus is one of the constituents especially liable to segregation, rails from the upper portion of an ingot, of course, run the risk of being of porous material and especally high in phosphorus. The manufacturers up to the present have refused to be bound to any definite percentage of discard.

"In addition to the ordinary defects the ingots of the steel companies have of late years been growing more porous and less homogeneous in the ceaseless endeavours of the manufacturers to run their mills to

their utmost capacity. Pouring immediately after filling from the ladle has the effect of preventing any slag carried into the ladle from the converter or furnace from rising to the surface, and tends to make the metal in the ingot mould still less homogeneous. Then comes the question of rolling, the number of passes being very much reduced in the modern processes, not only because of 'improved' methods, but also because of the fact that the ingot remains the same size while rails now are of 100-pound section against 65-pound of a few years ago. The rail has therefore less work put into it, and the wearing part of the rail is finished at a higher temperature than formerly, resulting in a rail of poorer qualities. The manufacturers claim, however, that all improvement in process and correspondingly increased output has resulted from cutting down the waste time between stages, and is not due to, for instance, quick rolling at high temperatures. The increased speed, they claim, is not due to their desire for high dividends, but to the fact that a high finishing temperature is necessary, owing to the particular form of section of American rails. The heavy head, the thin web, and the wide and thin base necessitate high finishing temperatures. Otherwise it would be impossible to roll the base or bottom flange. This, perhaps, is the soundest of all the excuses advanced by the steel companies in their attempts at self-justification, the others being merely shifts to enable them to pass off lightly the present serious state of affairs. So strongly placed are they that even now, when the gravity of the situation has been brought prominently before the world, the buyers do not seem able to enforce their full demands, and the manufacturers still appear to be masters of the situation.

"The ideal rail is one on which all the above-mentioned points have a very material bearing. Phosphorus must be low, with, if anything, a tendency to a lower percentage as the percentage of carbon increases. While a rail containing up to 0.1 per cent. phosphorus may be serviceable with low carbon, if the carbon is increased the rail becomes unduly brittle, unless the phosphorus is decreased. In order to obtain good wearing rails, there is a tendency to use a higher percentage of carbon than formerly, and it therefore follows that the phosphorus must be present in smaller amounts. The rolling must be so managed that sufficient work is put into that part of the rail which will be subjected to the greatest wear—*i. e.*, the head—which must not only be sound in material, but well worked and of close structure. The holding of rails before the last pass or two, so as to finish at a proper temperature merely produces a rail with a hard skin and of poor internal structure; and when the skin is worn away the soft material inside wears rapidly, even if defects have not caused failure before this stage is reached. The spraying of the heads of rails during rolling is also therefore at best an unsatisfactory expedient. Bearing on this point is the question of section, which should be of such form that the process of rolling and working of the material may be carried on in the manner best calculated to provide a good wearing rail. It should not be necessary to have to resort to annealing, which destroys the beneficial effect of rolling."

The editorial gives a review of the work and influence of the various technical societies in attempting to arrive at a solution of the problem and then concludes as follows:

"In the meantime the manufacturers take credit to themselves for the fact that although the trade is organised so as virtually to result in monopoly, the price of rails has been maintained at a constant figure for the last four or five years. They take care not to mention the economies they have resorted to during this time, with such disastrous results to the buyers. The situation at the present moment cannot be considered as satisfactory, the most rational specifications—*i. e.*, those favoured by the American Society of Civil Engineers and the American Railway Engineering and Maintenance-of-Way Association—being rejected by the manufacturers. That buyers have just cause of complaint we have clearly shown above, and that American rails have no good reputation abroad at the present time is emphasised by their shrinkage in exports to Europe of recent years. In the first seven months of 1906, for instance, rails to the value of 22,422*l.* were exported to Europe, as compared with 245*l.* worth in the corresponding period of this year.

"Improvements may be sought, as we have shown, in several directions. The Sandberg process of 'added silicon' tends, as was shown at the Engineering Conference held in London this summer, to the production of sounder metal. Open-hearth steel may ultimately displace Bessemer for rail material, and there is, without doubt, a strong desire to effect the substitution at present only partially possible. Vanadium steel rails are to be tried on some systems, such as the Atchison, Topeka, and Santa Fé. Until, however, the manufacturers make such concessions as will ensure a product of a quality considered by practical engineers as the minimum allowable, the railroads will be put to considerable expense and trouble, while the public, falling between the two stools, travel at uncomfortably high risk."

THE ELECTRIC POWER SUPPLY OF PARIS.

A PROJECT FOR THE DEVELOPMENT OF THE WATER POWERS OF THE RHONE AND THE TRANSMISSION OF THE ELECTRIC POWER TO PARIS.

G. de Lamarcodie—Revue Générale des Sciences.

IN THE ENGINEERING MAGAZINE for November, 1907, these columns contained a description of the immense water powers awaiting development in France, in which the district of the Rhone was mentioned as a possible source of some five million horse-power of electrical energy. A recent number of the *Revue Générale des Sciences* contains a description of a project for the utilization on a large scale of the power of the Rhone itself, and the transmission of electrical energy to Paris, a distance of 450 kilometres. An outline of the scheme as given by M. G. de Lamarcodie after a report by M. Harlé, one of the engineers interested in the project, is contained in the following abstract.

Commenting on the other notable long-distance transmission systems of the world, M. de Lamarcodie points out that, while electrical energy is not at the present time transmitted over so great a distance as 450 kilometres, projects are on foot, notably at Stockholm and the Victoria Falls, for transmissions over much greater distances. There is nothing in the experience of those responsible for the present long-distance transmissions, up to 350 kilometres, to indicate that the project is impracticable.

The demand for power in Paris is next considered. It would be possible to dispose of power to the underground railways and a cheap supply of power would induce the steam railways to use electric traction over their suburban lines. These demands, together with the demands for power for lighting, tramways and manufacturing, would insure a consumption of about 700 million kilowatt-hours per annum. It is not to be expected that this figure would be reached at once, but that the demand will increase as consumers become assured of regular and efficient service.

The Rhone was chosen as the source of power only after careful consideration of the other possible localities. In these, notable Savoy and Upper Savoy, the streams are too swift for the establishment of large generating stations and besides a great many of the waterfalls are already utilized to supply local demands for power. The Rhone has two distinct advantages: first, its discharge, which never falls below 130 cubic metres per second; and second, the rapidity of its fall which, in the 22½ kilometres between the Swiss frontier and Génissiat bridge, amounts to 65 metres. At least 80,000 horse-power could be generated at low water and about double this during 300 days out of the year, while in time of flood the discharge reaches 1,250 cubic metres per second. Further, the Rhone could be utilized for the supply of power to Paris without prejudice to the requirements of local industries, whose demands are already satisfied from other sources.

It is proposed to erect a very high dam at the lower end of the narrowest part of the Rhone gorge. The most convenient spot for the dam seems to be the neighborhood of Génissiat. A difference of level between this point and the Swiss frontier of about seventy metres can be counted on. The Lac du Bourget will be utilized as a compensating reservoir to do away with variations in the regimen of the Rhone due to variations in the operation of the plant.

It was at first intended to transmit the

energy by direct current at 120,000 volts on the Thury system, but subsequent changes in the law relating to the transmission of electrical energy have removed the advantages of the direct-current transmission to a great extent and it is now proposed to use three-phase alternating current at the same voltage, transmitting to Paris the 70,000 kilowatts proposed over two lines of slightly different lengths. The current will be generated at 10,000 to 20,000 volts, stepped up to 120,000 for transmission, and stepped down to 10,000 to 15,000 for distribution in Paris. The cables will be carried on steel transmission towers spaced 100 metres apart. On account of the regulations concerning the transmission of alternating current, the transmission line will have to be situated entirely on private property. It is expected that the loss in the line will not exceed 12½ per cent. and that a regular annual transmission of 500 million kilowatt-hours can easily be maintained, taking into account only the mean supply of water in the Rhone.

M. de Lamarcodie considers that the carrying out of the project is not only practicable but necessary from an economic point of view. A supply of cheap power would be of immense advantage to the industries of Paris, and this the project offers. The great consideration urged in opposition to the scheme is the possibility of an interruption to the service due to accident, but the promoters have taken care to guard against this by the provision of a double line. All things considered, M. de Lamarcodie regards the project well worthy of development and one which should receive hearty financial support.

INDUSTRIAL BETTERMENT IN AMERICA.

A SUMMARY OF THE LINES ALONG WHICH THE INDUSTRIAL BETTERMENT MOVEMENT HAS DEVELOPED IN THE UNITED STATES.

H. F. J. Porter—American Machinist.

THE industrial betterment movement in the United States is of comparatively recent origin. It is only within the last ten years that the subject has been given any attention and only within the last five that its merits have been generally acknowledged. During the latter period, however, its growth has been extraordinarily rapid, as employers of labor have come to recognize that the loyalty of employees, to be gained not by policies of philanthropic and patronizing paternalism, but by a common-sense consideration for their health, safety and recreation, is a most important factor in commercial success. The gradual growth of the movement has been shown from time to time, in articles in the pages of THE ENGINEERING MAGAZINE, but the following summary of the lines along which it has developed, taken from a recent paper by Mr. H. F. J. Porter in *American Machinist,* will prove of interest.

"As men do not engage in business from altruistic motives, modern methods of factory management cannot be based on sentiment, but on sound economic principles. The object of any industrial enterprise is to make money for its promoters. In order to do this, expensive machinery is bought and placed in the factory where it will best do its work; it is protected from dust, kept well oiled and in good repair. Just so must the human beings who operate the machines be kept in good condition, physically, morally and mentally, if the employer is to receive the greatest return for the wages he pays. Good light, air, cheerful surroundings, cleanliness and provision for the reasonable degree of comfort which prevents over-fatigue and induces good work—all these things have a commercial value, for, the more favorable the conditions surrounding work, the better will be the class of workmen attracted, the greater their efficiency and the more permanent their service.

"A quarter of a century ago certain Dutch and German manufacturers introduced into their establishments many innovations in factory management tending toward the safety, health, comfort and happiness of their employees, changes which redounded to the benefit of both workers and work. Such instances, rare in Europe, were unknown in the United States. Ten years ago comparatively few men here gave any thought to such matters. But Amer-

icans have become as great travelers as their English cousins. Being quick to recognize good things and to turn them to account, American business men have, within the past five years, adopted many foreign industrial betterment ideas, changing and enlarging upon them, in order to adapt them to their economic requirements.

"Massachusetts manufacturers were the first to interest themselves in this direction. They were quickly followed by others in the Middle Western and Western States, and later on, by Southern industrialists. To-day some form of industrial betterment finds a place in our more successful factories, machine shops, foundries, mills, etc., until America is now foremost in such work. Improved factories are greater in number in the United States than elsewhere, and also have greater diversity in their social, educational and recreational features. The wide spread of these ideas is due not to the fact that successful concerns have adopted them, but because it has been noted that concerns which adopt them become successful."

Perhaps the initial indication of interest in industrial betterment on the part of an employer is to be found in the generally manifested desire for order and cleanliness in and about the works. New buildings are usually built with large window space to admit plenty of light and air. Many firms have gone very far in beautifying the surroundings of their work-people and have found the result extremely satisfactory. The most important phase of the movement, however, is the increased interest in safeguarding the operatives from accident in the more or less hazardous trades.

"A great menace to our industrial system is the destruction of life which results from the use of machines operated at a high rate of speed. The number of fatalities would be beyond belief but for statistics, which tell how many are killed and maimed in various industries. Census Bulletin No. 83 shows that the number of deaths by accidents and violence in the United States in 1900 was 57,513. These figures are increasing annually. Thus our peaceful vocations cost more lives every two days than all that we lost in battle during our war with Spain.

"In 1899, the New York Bureau of Labor attempted to gain as complete a record as possible of all accidents for three months in industries employing about one-half of the factory workers in the State. During this period confessedly incomplete returns showed 1,822 accidents. On this basis all the factories in the State would in twelve months show 14,576 accidents. But these figures are undoubtedly far below the facts. Many trades, not particularly dangerous, reported 44 accidents for every thousand employees, while some extra-hazardous trades reported only 16 to a thousand employees. As there is a disposition to conceal accidents, it is safe to assume that no employer reported more than actually occurred, so that the Commissioner of Labor reasonably inferred 44 to a thousand to be more nearly correct than 16 to a thousand.

"On this basis there would be upward of 332,000 factory employees killed or injured annually in this one great division of the industrial army in the United States. Undoubtedly the safeguarding and protection of life and limb is a most important phase of industrial betterment. Factory legislation during the past five or six years has done much to reduce the danger of accidents, but there are still far too many of them. Employers are not eager to place safety devices upon already expensive machinery; good operatives frown upon anything which tends to restrict the output. It sometimes happens that a serious accident is necessary, as an object lesson, before workmen will appreciate or use a device installed for their own protection. There are places, however, where labor accidents for years have been reduced to a minimum by protective improvements, long before their use was required by law.

"As great financial loss may result from the ill health of employees, great care is taken in accepting only those who are physically sound. Those already employed, who are affected by tuberculosis, are especially provided for, while new applicants are not accepted. Alcoholism, the bane of efforts to secure regularity of attendance, is fought by elimination and rejection of its victims. The hygiene of the buildings receives attention; wash rooms with individual basins are often provided; shower baths in foundries are occasional; sanitary closets are common. The dust from

grindstones and similar apparatus is carried off to prevent its being inhaled by the operatives. Ventilated clothes lockers are considered necessary. One factory gained the regard of its employees and drew to it the best element from neighboring works by putting a steam pipe under its clothes lockers. Workers arriving on a wet morning changed their wet clothes and shoes for others dry and warm, and at night found their street suits thoroughly dried for their return home.

"Medical service, ranging from simple emergency cases and first-aid classes up to hospitals with the finest equipment, is provided in the modern factory and shop. Almost all improved establishments have some provision for the care of accidents and cases of sudden illness. Usually it takes the form of a room fitted up as a miniature hospital, with a trained nurse in charge. More elaborate systems of medical service are installed in large plants where the work is hazardous in character. The Colorado Fuel and Iron Company has a splendid hospital at Pueblo, in addition to simpler forms of medical relief in the various mining camps. The Illinois Steel Company, at South Chicago, maintains a hospital with constant medical and surgical attendance."

Other features of the movement, not so widespread, are the establishment of suggestion systems and of long-service pension systems, the building of workmen's cottages where transportation facilities are bad, and the establishment of libraries, educational systems and club-houses and gymnasiums by some of the larger corporations.

"Business men, hearing of this much talked about and written about industrial betterment, question if it is really worth the time, thought and money spent upon it. They do not realize that the absence of these features also costs money, through their getting an inferior quality and less quantity of output. Results fully justify the expenditure, which may be either great or small, according to the number of employees and the kind of betterment work which is done. Employers who have had experience with it are enthusiastic, because better work and greater output show the definite, tangible effect it has upon the men. Working people approve because of the advantages it places at their disposal. It is, however, a failure, something worse than useless, if forced upon employees. It must exist only by reason of a need, or an expressed desire, for it upon the part of the men themselves and must be free from the least taint of exploitation or paternalism, which American workmen universally and rightly resent. Where industrial betterment ideas are properly initiated and carried out, the beneficial effect is incalculable, for they reach not only the individual but the outside world. They raise the standard of the man; the quality of his work improves and the consumer gets a better article for his money.

"There is a force in nature which continually makes for progress. Give this force the opportunity to exert itself through the initiative of the working organization. Help the employees to help themselves. Their appreciation of the benefits accruing to them will bring a hundred-fold return to the management."

THE CALIBER OF SEACOAST GUNS.

A DISCUSSION OF THE RELATIVE MERITS OF INCREASED CALIBERS WITH LOW VELOCITIES AND SMALLER CALIBERS WITH HIGH VELOCITIES.

Major H. L. Hawthorne—Journal of the United States Artillery.

A QUESTION of considerable importance to the coast defense of the United States is argued by Major H. L. Hawthorne in the current number of the *Journal of the United States Artillery.* It is proposed by the Ordnance Department to replace the present 12-inch high-velocity guns with guns of 14-inch caliber and lower velocity, on account of the effect of erosion on the life of the former type. As the following extracts will show, Major Hawthorne reaches conclusions directly opposite to those accepted by the Ordnance Department.

"In the gradual development of seacoast high-power guns in the United States, increase in power was at first sought in increase of caliber until the 12-inch gun was

produced. This type in turn underwent a gradual increase of power through an improvement in the quality of steel, the elongation of the bore and a more rapid device for manipulating the breech mechanism. In the attainment of this increase of power, a higher and higher muzzle velocity was sought, which appeared for a time to be limited by the bursting effect of powder, the maximum being controlled by the rate of burning and the strength of construction of the gun. So long as such factors only entered into the problem of increased velocities, there was no reason why progress in that direction should not have continued; but a serious menace to further advance appeared in the form of erosion produced by the high temperature and volume of the gases from smokeless powders in the bore of the gun, seriously affecting its accuracy, but, what was still more important, so reducing the life of the gun that the movement in the direction of increased initial velocities has been compelled to meet this destructive influence by expedients, or seek for the desired increased power, not by greater velocities but by larger calibers and longer life of guns by lower velocities. Many elements enter into the consideration of this question, apart from the simple increase in power, which would avail little, if all or some of them are sacrificed. In order to present an introductory basis for a discussion of this question, there will be presented at once the claims and counter claims as to a solution of it, by an increase in velocity without change of caliber, or an increase in caliber with lower velocity."

Major Hawthorne lists seventeen of the claims made for the 12-inch gun with 2,250 and 2,500 feet per second muzzle velocity and the replies of the advocates of the 14-inch gun with 2,150 feet per second muzzle velocity. There are dealt with the varied questions of rapidity of fire, ease of handling ammunition, ease of ramming, accuracy and power, accepted practice, mechanical details, cost of gun and charge, life, etc., the arguments covering practically all the controversial points and being presented without bias. Major Hawthorne then proceeds to give his own views as to the advisability of making the change.

"The recent recommendation of the Ordnance Department that high velocities and heavy powder pressures be abandoned, and that we return to the old system of firing heavier projectiles with smaller velocities is a complete acknowledgment of defeat in the struggle between armor and gun. Although the heavier projectile with lower velocities may for a time bring the gun once more to the front, the advantage may be but temporary and an improvement in the resisting power of armor, or its increase in thickness may again force higher velocities on the gun, and this time may find the construction of the gun, with its lighter weight and short barrel, unequal to any advance in that direction. Recourse must again be had to the 12-inch type of gun construction with an increase in velocity, thus finding ourselves where we have now arrived, but with a great expenditure of time and money on guns no longer of value.

"The problem is, therefore, to meet the evil effects of gun erosion and continue on that line until every possible method of prevention has been tried."

The most severe erosion of the bore takes place near the breech in the neighborhood of the seat of the projectile. It decreases towards the centre of the bore and tends to increase towards the muzzle. One theory to account for this is that the metal of the bore is worn away by the rush of the white hot gases through the openings left when the shell is rammed home into place; an obvious remedy would be to devise some more perfect method of obturation of the base of the projectile. Another theory is that the intense heat of the explosive gases, circulating in currents of enormous velocity, raises the inner surface of the gun almost to a melting temperature and renders it extremely liable to erosion by the corrosive action of the gases. This theory would suggest the advisability of reducing the temperature of the gases by the use of some inert volatile solid in connection with the powder. The eroding action of the gases is increased by the use of oxidizable metal in the inner tube of the guns. It might be found possible to use high-speed steel for these tubes. Its cost is very high and it is difficult to work, but the advantages of longer life might be found to outweigh the difficulties.

Major Hawthorne refers to tests made at Sandy Hook, the Springfield Armory, and other places to determine the amount of

erosion under various conditions and then gives a summary of the possible means by which it may be reduced or prevented.

"Summarized, the various corrective methods that have been experimented with, more, or less, and the deductions therefrom, and from examination of the erosive action in guns of high power, it is thought that beneficial results will follow from:—

1. Some special form of rotating band, acting to close the bore when the projectile is rammed home and keeping it seated during the passage of the shot down the bore.
2. The elimination of the forcing cone, keeping the lands to their full thickness to the seat of the projectile.
3. Uniform twist rifling.
4. A lower oxidizable metal for the tubes of guns, and one capable of better resistance against great pressures and intense heat.
5. Reduction of powder pressures and greater length of gun, up to 45 calibers.
6. A change in the composition of the propelling charge, by which no loss in velocities is incurred, but which will bring about a reduction of temperatures of the evolved gases.
7. Reduction of the density of loading, by increasing capacity of the powder chamber.

"With the elimination of erosion," he concludes, "the change to lower velocities and large calibers is unnecessary, and the high qualities of the 12-inch, model of 1900, can be retained, with the following resultant advantages over the larger guns:

1. Greater danger spaces.
2. Sufficient striking energy and size of explosive charge.
3. Extreme range.
4. Greater rapidity of fire.
5. Greater accuracy.
6. Simpler methods of breech closure and shot handling.
7. Less cost.
8. Superiority of accuracy over guns afloat."

THE DEVELOPMENT OF MARINE TRANSPORT.

A BROAD VIEW OF THE INFLUENCE OF THE INCREASING SIZE OF SHIPS ON THE PROVISION OF DEEP WATERWAYS AND OF HARBOR AND DOCK ACCOMMODATIONS.

Sir William Matthews—Institution of Civil Engineers—Engineering.

IN his recent presidential address before the Institution of Civil Engineers, Sir William Matthews touched but lightly on the mechanical and structural engineering features of marine transport, but gave a broad and interesting review of the development of harbor and dock accommodations and of deep waterways, made necessary by the increasing size and draught of steamships. The following abstract taken from the editorial columns of *Engineering* will give an idea of the scope and interest of the address.

"The general question of over-sea transport has, in view of recent developments, a special interest at the present day. For some occult reason our daily Press is much more alive to real or imaginary progress made in other countries than it is to similar events at home. We read much about the developments of foreign ports and harbours, whilst little is said as to still greater advances made within the United Kingdom. The mere fact of its transmission by cable, indeed, seems to bestow upon news of this character a fictitious importance out of all proportion to its intrinsic value, and hence data as to the work of the Harbour Commissioners at our principal ports, though appearing, it is true, in the local Press, rarely get transcribed into the metropolitan papers. The new President's address goes far to fill this void, and to show that our various port authorities are rising to their responsibilities, so far as financial considerations allow. These have been most seriously strained by the advent of the giant ship, which, on the very day of the delivery of the address, was signalised by the last of them, the Mauretania, exceeding all previous speed records for Atlantic liners. In preparation for this and her sister-boat and other great liners, Sir William pointed out that the entrance to the Mersey is being dredged so as to admit, at all stages of the tide, ships of 1,000 feet in length and requiring 40 feet depth of water. As matters stand, a depth of 28 feet is even now available at low water, as against 11 feet in 1890. At

the same time the dock-floors have been lowered from 20 feet to 30 feet depth, and a new graving dock built 925 feet long by 94 feet wide at the entrance. At Southampton provision is being made for berths 35 feet deep at low water, which will ultimately be increased to 40 feet. At Newport the new lock is 1,100 feet long by 100 feet wide at entrance, with 44 feet 6 inches depth over the sill. London, unfortunately, in spite of its standing as the first port in the kingdom, can as yet show no corresponding efforts to meet the requirements of the giant ships. This is no doubt mainly due to financial considerations, since owners of moderate-sized vessels not unnaturally resent the imposition of dues, the sole effect of which will be to facilitate the competition—already sufficiently serious—of these enormous steamers. Nevertheless, the Conservancy are engaged in constructing a channel giving a depth of 30 feet right up to Gravesend. Sir William points out in his address that Brunel fully realised the advantages, in the matter of economy of working, of the large ship. The mistake made in the case of the Great Eastern was an undue confidence in the forthcoming of cargoes sufficient to load her, since all the advantages of the big boat are lost if she has to wait in harbour to collect freight. As matters stand, the biggest boats are still unsuitable for any trade but that between Europe and the United States, and would probably prove ruinous to their proprietors if engaged in any other traffic.

"Much has been heard of late years of the great development of Antwerp as a port for ocean-going steamers, and undoubtedly the port authorities there have been most enterprising. From Sir William Matthews' address, however, it would seem that there is still much to be done there before the port can fairly vie with Liverpool or Southampton, since in the approaches at low water the limit of draught is 16 feet, though in the port proper there are berths giving 26 feet to 33 feet depth alongside the river quays. Though the Suez Canal at present restricts the draught of ships trading to the East, the port authorities there are, in some instances, making provision for the advent of very large steamers. The great economy with which these can be run may, perhaps, do something to restore the popularity of the Cape as a route to the East. At present the limit of draught for the Suez Canal is 27 feet, which, however, may be increased to 30 feet by 1909. Even then, however, the heavy dues may make the Cape route preferable for large cargo-boats.

"Referring to the Panama Canal, the President noted an important novelty in the methods adopted by the Americans to facilitate its construction. This has no relation to any of the machinery employed—which, though large, is not essentially new in character—but to the extraordinary and quite unprecedented attention paid to sanitary and hygienic considerations. Here, indeed, would seem to be the dawn of a new era in the conduct of engineering works in tropical climates. The Panama Railway, it used to be said, passed through a cemetery of the Chinese navvies who had been engaged in its construction, and the death-roll of engineers engaged in West Africa has also been exceptionally heavy. It is these extraordinary dangers to health which have hitherto rendered commercially impossible the due development of the enormous natural wealth of many tropical climes. Thanks to experimental biology, however, the origin of these malarious and other similar diseases is being gradually elucidated; and to the Americans belong the credit of being the first to make intelligent and systematic use of the facts so far acquired. From a merely pecuniary standpoint the sanitary campaign at Panama will probably save millions of money—in an indirect fashion, it is true; but from the contempt for expert knowledge which seems the characteristic peculiarity of some of our native politicians, it will, we fear, be a long time before the American example is followed in similar circumstances by our own authorities.

"Some exceedingly interesting data were advanced by Sir William Matthews concerning the extraordinary depths at which material may be moved by wave action and ocean currents. Stones weighing one pound have been, he records, drifted into lobster pots sunk in 20 to 30 fathoms of water. At Peterhead blocks 41 tons in weight have been shifted by the waves, though situated 37 feet below low water of spring tides. In the earlier portion of his address he referred with admiration to the enormous

natural resource and great courage of the pioneers in the engineering profession, an appreciation which is, no doubt, in part due to a keen fellow-feeling. Like them, in the absence of data and adequate scientific theories, the harbor engineer must trust to his judgment, and not to mathematics for the proportions which he gives his structures. What will stand well at one place may prove totally inadequate at another. At Dover, for instance, the highest wave recorded in the course of fourteen years' observation has been 18 feet, whilst at Peterhead they reach 40 feet. Again, many mistakes have been made by harbour engineers in endeavouring to improve the approaches to sandy estuaries by training the currents. The situation and probable effect of any wall has had to be fixed by judgment rather than by formula, and, indeed, it is now recognised that what may be called the natural method of maintaining a good depth at low water must be supplemented by mechanical means. The improvement of the Mersey has been largely due to the introduction of the pump-dredger, and the same implement has proved its value at Durban and other ports suffering from sandy bars. The work of the harbour engineer is therefore empirical to an extent unusual in other branches of the profession, and he can accordingly, with a peculiar sympathy, appreciate the labours of the pioneers of the industry.

"In concluding his address Sir William gave some valuable data as to recent advances in the matter of protecting life at sea. Although the submarine sound-signals were introduced but three or four years ago in a commercial form, they are now, he states, in use on all the principal Atlantic liners. By their means the bearings of an approaching vessel or a suitably equipped lightship can be accurately located in the densest fog. Submarine bells have therefore been applied at the approaches to New York, Liverpool and Cherbourg, and Trinity House is, Sir William says, now taking steps to fit them to a number of important lightships. Lighthouses, he remarks, have had their value increased by the substitution of incandescent oil-lamps for the ring burners previously used; whilst where the electric light is in use the adoption of the 'flame' arc has substantially augmented the penetration of the luminous beam during the prevalence of thick weather."

THE NEW BRITISH PATENT LAW.

A SUMMARY OF SOME OF ITS MORE IMPORTANT AND NOVEL PROVISIONS.

J. A. Law—Journal of the Society of Arts.

THE new British patent law which comes into effect on January 1, 1908, contains many alterations of the previous patent regulations of the utmost importance to manufacturers, inventors and others. It is impossible in a short review to notice more than the most striking innovations, and the following extracts from an article by Mr. J. A. Law in a recent number of the *Journal of the Society of Arts* give a summary only of the more important provisions relating to the granting, working and conveying of patents. The provisions of the Act are retroactive.

The most important provision is that respecting the compulsory working of patents in Great Britain. "If a patented article or process be manufactured, or carried on exclusively, or mainly outside the United Kingdom, then, unless the patentee prove that the patented article or process is manufactured or carried on to an adequate extent in the United Kingdom, or give satisfactory reasons why it is not so manufactured or carried on, the Comptroller may make an order revoking the patent forthwith, or he may make an order revoking it after a specified interval if the patented article or process be not in the meantime adequately manufactured or carried on within the United Kingdom; but in the latter case, if the patentee give satisfactory reasons for the failure so to manufacture or carry on within the prescribed time, the Comptroller may extend the period by not more than one year. To obtain such an order, application must be made to the Comptroller at least four years from the date of the patent, and one year from the passing of the Act; moreover, any decision of the Comptroller is to be subject to an

appeal to the High Court, and no order is to be made that will be at variance with any treaty, convention, arrangement, or engagement with any foreign country or British Possession.

"This provision, which, according to Mr. Lloyd-George, is the pith of the Act, introduces a very important alteration into the law relating to patents. It is true that under the previous law it was possible that a patent might be revoked on a somewhat similar ground, namely, that the reasonable requirements of the public with respect to the patented invention had not been satisfied; but this was only as an alternative to the grant of a compulsory license, and no patent has, at any rate in modern times, been revoked on such a ground. Whether the policy of revoking patents for a lack of working in this country is sound or not, is at any rate very debatable, and the writer has previously advocated the placing in the hands of the Comptroller, in lieu of the power to revoke, the power to grant to suitable applicants licenses to work patents that have not been worked in this country for a given time after their grant."

With a view to cheapening the procedure, petitions to the Board of Trade for the grant of compulsory licenses or the revocation of patents are to be referred by the Board of Trade to the High Court instead of to the Judicial Committee of the Privy Council. "It is also enacted that the reasonable requirements of the public shall not be deemed to have been satisfied if, by reason of the default of the patentee to manufacture to an adequate extent, and supply on reasonable terms the patented article, or any parts thereof necessary for its efficient working, or to carry on the patented process to an adequate extent, or to grant licenses on reasonable terms, any existing trade or industry, or the establishment of any new trade or industry, in the United Kingdom, be unfairly prejudiced, or the demand for the patented article, or the article produced by the patented process be not reasonably met; or if any trade or industry in the United Kingdom be unfairly prejudiced by the conditions attached by the patentee, before or after the passing of the Act, to the purchase, use, or hire of the patented article, or to the using or working of the patented process.

"In any contract made after the passing of the Act in relation to the sale or lease of, or license to use or work, any article or process protected by a patent, any condition will be null and void that will either (*a*) prohibit or restrict the purchaser, lessee, or licensee from using any article or class of articles, whether patented or not, or any patented process, supplied or owned by any person other than the seller, lessor, or licensor, or his nominee; or (*b*) require the purchaser, lessee, or licensee to acquire from the seller, lessor, or licensor, or his nominees any article or class of articles not protected by the patent. The provision, however, is not to apply if the seller, lessor, or licensor, prove that at the time when the contract was entered into the purchaser, lessee, or licensee had the option of purchasing the article or obtaining a lease or license on reasonable terms, and without such objectionable conditions; and if, also, the contract entitled the purchaser, lessee, or licensee to relieve himself of his liability to observe the objectionable conditions on giving the other party three months' notice in writing, and on payment of such compensation as may be fixed by an arbitrator appointed by the Board of Trade.

"Any contract relating to the lease of or license to use or work any patented article or patented process, whether made before or after the passing of the Act, may, when the article or process is no longer protected by a patent, be determined by either party on giving three months' notice in writing to the other party; but in the case of any contract made before the passing of the Act, such determination is subject to the payment of compensation.

"It is no secret that the section in question was chiefly aimed at the methods of the American Trusts, one of which, according to Mr. Lloyd-George, has practically compelled the boot industry in this country to employ their machines exclusively, and has obtained contracts with the manufacturers such that if an improvement on the invention to which the contracts relate, were taken up at the end of nineteen years, the trade would be bound to take the improvement, and renew their leases for another twenty years, and so forth, apparently *ad infinitum*. It was consequently necessary in the opinion of the Government to protect this very powerful

industry, and to say that this country really could not stand the use of a privilege conferred by the Crown for the purpose of hampering a whole trade.

"In addition to the present ground of opposition, the grant of a patent is to be opposable on the ground that the invention has been claimed in a complete specification that will be dated prior, but not more than fifty years prior, to the patent the grant of which is opposed, or on the ground that the nature of invention, or the manner in which it is to be performed, is not sufficiently or fairly ascertained in the complete specification. The former of these two new grounds is to enable the grant of a patent to be opposed on the basis of an application made in this country, and founded, under the International Convention, on a prior application made abroad.

"Any person who would have been entitled to oppose the grant of a patent, or the successor in interest of such a person, may, within two years from the date of the patent, apply to the Comptroller for its revocation on any ground on which the grant of the patent might have been opposed; but the leave of the Court is requisite when an action for infringement or proceedings for revocation are pending in the Court. The decision of the Comptroller is to be subject to appeal to the Court.

"Any ground on which a patent may be revoked by the Comptroller, or, as an alternative to the grant of a compulsory license on the ground that the reasonable requirements of the public with respect to the patented invention have not been satisfied, is to be available as a defence to an action for infringement, or as a ground for revocation by petition to the Court.

"In an action for infringement a defendant entitled to present a petition to the Court for the revocation of the patent may alternatively counter-claim for revocation.

"Hitherto, to obtain the prolongation of a patent, it has been necessary to present a petition to the King, and the petition has been referred to the Judicial Committee of the Privy Council, with the result that the obtaining of an extension of the term of a patent has been a very costly matter. After December 31st, 1907, a patentee may, at least six months before the time at which the patent would ordinarily expire, present a petition for its extension to the Supreme Court. It is, therefore, to be hoped that the cost of securing such extensions will be materially reduced.

"Prior publication of an invention or any part thereof, if the matter published were derived or obtained from the patentee and published without his knowledge and consent, is no longer to be ground for the voidance of a patent, provided that the patentee, after learning of the publication, applied for and obtained protection for his invention with all reasonable diligence.

"No damages can be recovered for infringement of a patent granted after December 31st, 1907, from any person proving that at the date of the infringement he was unaware, and had no reasonable means of making himself aware, of the existence of the patent. The application to a patented article of a word indicating that a patent has been obtained is not to be deemed to constitute notice of the existence of the patent, unless the year and number of the patent be added. . . . . .

"A patent granted to an inventor in lieu of a patent revoked on the ground of fraud, is to bear, instead of the date of revocation, the date of the revoked patent, but no action is to be brought for any infringement of the patent so granted committed before the date of the actual grant of the substitutional patent. The alteration in the dating of the substitutional patent is important from the point of view of priority.

"Under the present law the grant of a patent to joint applicants gives a joint interest which passes to the survivor or survivors, unless there has been a severance of that interest, and each patentee can retain any profits he may make by working the invention himself, though it is questionable whether if he grant licenses, he will not be accountable to his co-patentees for the royalties obtained. Under the new law, unless otherwise specified in the patent, joint grantees are to be treated for the purpose of the devolution of the legal interest as joint tenants, but, subject to any contract to the contrary, each, whilst being entitled to use the invention for his own profit without accounting to the others, is not to be entitled to grant a license without their consent, and on his death his beneficial interest is to devolve on his personal representative as part of his personal estate."

THE UTILIZATION OF LOW-GRADE FUELS.

A CONSIDERATION OF THE ECONOMIC IMPORTANCE OF CONSERVING FUEL SUPPLIES AND OF THE APPLICATIONS OF THE GAS PRODUCER.

F. E. Junge—American Society of Mechanical Engineers.

THE paper of most general interest presented at the recent annual meeting of the American Society of Mechanical Engineers was that by Mr. F. E. Junge on "The Rational Utilization of Low-Grade Fuels." The paper gives a broad view of the economic and political importance of husbanding national resources and shows that the desired result can best be attained by the general application of the gas producer to the utilization of the immense deposits of low-grade fuels which are at present undeveloped and of other materials which now go to waste. The following brief abstract gives an outline of Mr. Junge's argument.

"The question whether an exhaustion of what we have termed our irreplaceable fuel resources is a danger for the life and prosperity of future generations, can only be discussed on the basis of theoretical prognostications and speculative arguments. The other question, whether for the benefit of present activities it is wise to economize in the methods of utilization of these resources, cannot be answered but in the affirmative.

"It is but a matter of political prudence for a nation to exploit the low-grade fuel materials of the country, such as peat, dust coals and refuse, if they can be used for the generation of heat, light and power, instead of wasting anthracite and coke, and to reserve the latter coals for more profitable and important uses in the metallurgical and other industries. An efficient utilization of coal, generally speaking, tends towards the preservation of national values, making a country self-supporting and independent of the world's markets. It also aids the prevention of hygienic abuses which, if not amended, are apt prematurely to weaken the earning capacity and the industrial activity of a nation.

"From whatever point of view we look at the problem, it remains a matter of the greatest economic importance to find methods and means for utilizing the enormous stretches of lignite and peat lands, especially those located in the neighborhood of large undeveloped bodies of rich ore which abound in remote districts of the United States and elsewhere, and either to transform the raw coals into some form of available energy which can be transmitted over long distances at reasonable cost, or to refine the low-grade fuels into superior products such as briquettes, or coke, or chemicals, that they may serve as a basis for other industries to grow upon and prosper. The question which remains to be settled then is not *whether* we should use the inferior classes of coal, but *how* we can use them most efficiently."

Lignites and peats should not be called low-grade coals on account of their low carbon, high moisture and high ash contents in the face of recent developments. Culm banks and other waste, obtained largely in coal mining, are the only materials which can rightly be called low-grade fuels, since their contents of *both* fixed carbon and volatile hydro-carbons is small. In boiler work, ash reduces the heating power of coal and actually obstructs the process of combustion to such an extent that an ash content of 40 per cent. will absolutely destroy the value of a fuel for raising steam. In producer work these drawbacks are actually turned to advantage. High ash content will promote an even flow of material through the producer when properly treated, if the temperature is not allowed to reach a point where clinker and slag will be formed. Of course, a reduction of the incombustible matter by washing or briquetting is preferable since high quality and quantity of combustibles in a fuel make for more regular and efficient working of the producer plant and a gas of more uniform composition. In cases where it is necessary or desired to use coal in its raw state, however, high ash content cannot be regarded as a limiting condition when producers are employed. In Germany mine culm, containing 65 per cent. of ash and only 25 per cent. of combustible matter is gasified in

the Jahns type of ring producer with entire success.

Within certain limits moisture also is an assistance rather than a detriment in producer work. Besides acting as a preventative of excessive temperatures, moisture, when sufficiently heated, will enrich the gas by the addition of hydrogen and oxygen. Moisture is harmful only when large quantities of it are contained in the gas as produced. There is an economic limit for each material, however, which must not be surpassed.

The introduction of by-product coking was an event of great importance, resulting as it did in an increase of from five to ten per cent. in the yield of coke and a return from the sale of by-products varying from 75 cents to $1 per ton of coke made. But the process has not been so generally adopted as its value warrants. Taking the case of England, "if the total quantity of coke made in the United Kingdom for metallurgical purposes is reckoned at 10,000,000 tons at an average price of $3.30 per ton, the general adoption of by-product coke ovens would result in a saving of from $1,750,000 to $3,500,000 derived from the increased yield of coke, while up to $10,000,000,000 could be derived from the sale of by-products, provided that the intrinsic value of the latter would remain the same in the future as it is now." This has been the case in Germany where the annual gain from the sale of by-products is about $10,000,000, and the same process is now being applied to the utilization of lignite and peat. In Bavaria the latter is subjected to destructive distillation in the Ziegler furnace and yields an excellent metallurgical coke, gas for heating, lighting and power purposes, sulphate of ammonia, tar oil, creosote and paraffin. The utilization of lignite in a similar manner is also increasing rapidly in Germany since it was discovered that lignite tar oils can be used as fuel for Diesel and other oil engines.

The use of lignite briquettes is also increasing rapidly in Germany. "The heat value of brown coal briquettes ranges from 7,700 to 9,600 B. t. u. per pound, compared with an average of 4,900 B. t. u. per pound of raw lignite containing 45 per cent. water. Their heat density is such that up to three tons or 60,000,000 B. t. u. can be stored in a space of 100 cubic feet, hence their commercial distribution range is almost double that of the raw coal. They are an ideal producer fuel on account of the regularity of form and composition. The briquetting tests of the United States Geological Survey show that the Dakota lignites can be treated as successfully as the German brown coal, a fact which will vastly extend the territory which these fuels control."

In discussing the utilization of peat, Mr. Junge refers to the results obtained by Dr. Caro which were fully described in these pages last month. Of mine culm, wash banks, etc., he says:

"The rational utilization of these materials is of great importance for collieries, where they are available in enormous quantities, and where they have formed hitherto a real nuisance to the works management. Owing to excessive ash contents these banks could not be burnt under boilers, nor could they be dumped back into the mines on account of the danger of causing self-ignition of the remaining coal deposits. So they were either stored up in huge piles in the neighborhood of the pit or, where territorial limitations prevented this, they were transported by rail into neighboring dumping grounds, being thus absolutely useless and causing heavy expenditures. There are two possibilities of utilizing these low-grade coals: one is to gasify them in Jahns ring producers where their fuel value is utilized, the 25 to 30 per cent. combustibles yielding a gas free from tar and well suited for heating and power purposes. . . . . Another method is that developed by Dr. N. Caro, of Berlin, Germany. It is based on the observation that wash banks and other waste contain more nitrogen than that which corresponds to their coal contents. In Westphalian collieries it was found that wash banks, the coal contents of which show on analysis about 1.2 per cent. of nitrogen, contain up to 1 per cent. of nitrogen, though their total contents of combustible matter is only 25 to 30 per cent. Dr. Caro has succeeded in gasifying this material in producers of the Mond type especially equipped for the purpose, and besides getting a suitable gas he gains about 80 per cent. of its total nitrogen contents in the form of sulphate of ammonia."

Mr. Junge points out that very small sizes of coal can be used in specially designed producers or that they may be briquetted, when they will compete with the very best grades of coal. In conclusion he sums up the case for the gas producer thus:

"One fact stands out clearly: it is that, according to the present state of our knowledge, the rational utilization of coals of high volatile contents requires the adoption of gas producers with by-product recovery and the distribution of heat, light and power from gas-driven central stations to the neighboring districts, a scheme which is feasible only when operating on a large scale and where staple markets for the disposal of goods lie within the commercial distribution radius of the plant. Fuels of high ash contents, on the other hand, such as mine culm and other waste of low heat value, must be used at the spot in producers specially equipped for the purpose. Dust coals and similar fuels can either be gasified in producers particularly designed for their use, or they may be transformed into briquettes, whereupon competition becomes possible with the best grades of coal for all manner of application. In all cases the employment in the electrical central station of large gas engines is a logical supplement to the gasification of coals in producers and is the only means so far available for attaining maximum industrial economy in the operation of plants of some magnitude."

THE EFFICIENCY OF THE GAS ENGINE.

A RECORD OF EXTENSIVE EXPERIMENTAL INVESTIGATIONS ON THE INDICATED POWER AND MECHANICAL EFFICIENCY OF THE GAS ENGINE.

Bertram Hopkinson—Institution of Mechanical Engineers.

THE recent paper by Prof. Bertram Hopkinson, read before the Institution of Mechanical Engineers, is a most important contribution to the literature of the gas engine, clearing up, as it does, a great many points in connection with gas-engine efficiency that have hitherto been obscure and puzzling. The paper repsents a vast amount of careful experimental work, and Prof Hopkinson's descriptions of his apparatus and methods are extremely interesting and suggestive. It is impossible here, however, to do more than indicate briefly his more important conclusions.

"In the report of the Committee of the Institution of Civil Engineers on the Efficiency of Internal Combustion Engines, the following remark occurs: 'It would be desirable but for one circumstance to calculate the relative efficiency only from the indicator horse-power. But it appears that in the case of gas engines, and especially gas engines governed by hit-or-miss governors, the indicator diagrams do not give as accurate results as is generally supposed. The diagrams vary much more than those of a steam engine with a steady load, and the mean indicator horse-power, from the diagrams taken in a trial, may, it appears, differ a good deal from the real mean power.'

"This statement is fully borne out by the tests of the Committee, which show that the mechanical efficiency taken as the ratio of brake to indicated power varied from 80 per cent. to 94 per cent. in the three engines tested. These engines were of similar type, but of different sizes, and whereas the smallest of 5 horse-power showed a mechanical efficiency of 90 per cent. the intermediate engine of 20 horse-power showed a lower efficiency of 80 per cent. The Committee remarked that these values were obviously incorrect, and the values adopted by them for the mechanical efficiency were obtained by running the engine light and making an estimate of the indicated horse-power under these conditions. Assuming that the mechanical loss is constant at all loads, the indicated power at full load can be determined by adding the power absorbed at no load to the brake power. The mechanical efficiencies of the three engines found in this way were respectively 0.86, 0.866, and 0.888.

"These results are just what would be expected; the mechanical efficiency showing a slight improvement with the size of the engine.

"The opinion of the Committee quoted above is obviously important and may be expected to have a widespread effect in

gas engine testing. It throws doubt upon many of the efficiency tests on gas engines which have hitherto been made and published. Moreover, the method which the Committee themselves adopted for getting the indicated power from the brake power seems to require further investigation before it can be accepted as accurate. It may, no doubt, be assumed on the evidence of steam engine tests that under given conditions of lubrication the friction is practically independent of the pressure in the engine. But where as in the steam engine the whole of the mechanical losses are to be ascribed to friction, that is not the case in the gas engine, in which a considerable amount of power is wasted in pumping and is usually included in the mechanical losses. Moreover, with a given supply of oil, lubrication conditions in the steam engine are practically constant, but in the gas engine that is by no means the case. Great changes can take place in the temperatures of the cylinder walls in a comparatively short time, and this will affect the viscosity of the oil and therefore the work spent in friction. The author therefore determined to undertake an investigation with the object of finding whether the indicator power of the gas engine does, in fact, vary so much, and is so difficult of determination, as the report of the Committee referred to suggests. If it were found that the indicated power could be accurately determined directly, it was further desired to test, by direct comparison of brake and indicated power, the validity of the Committee's method of getting the mechanical efficiency. Briefly, the conclusions reached are:—

"(1) If precautions are taken to keep the pressure of the gas supply constant, the diagrams given by the engine are remarkably regular, and, whether the engine be missing ignitions or not, it is possible, by the use of a sufficiently accurate indicator, to obtain the indicated power from diagrams within 1 or 2 per cent. It seems probable that the difficulty experienced by the Committee was due either to the essential defects, for this purpose, of the ordinary form of indicator, or to casual variations in the gas supply per suction, due perhaps to variations in the gas pressure at the engine.

"(2) The difference between indicated horse-power and brake horse-power is rather less than the horse-power at no load under the same conditions of lubrication, mainly because of the difference in the power absorbed in pumping. In the particular engine tested by the author the error from this cause in obtaining the indicated power would amount to about 5 per cent. The friction is substantially constant from no load to full load, provided that the temperature of the cylinder walls is kept the same, but the influence of temperature is very great."

The engine used in the tests worked on the Otto cycle, with hit-and-miss governing, and was designed for a maximum output of 40 brake horse-power. Its cylinder dimensions were 11½ by 21 inches and the speed 180 revolutions per minute. The compression space was 407 cubic inches, compression ratio, 6.37, and compression pressure, 175 pounds per square inch absolute.

The result of Prof. Hopkinson's investigations show that the confusing results obtained have been due almost entirely to the inaccuracy of the ordinary indicator for gas-engine tests when high compressive charges are used. There is given a discussion of the extent to which the various sources of error in the ordinary indicator, friction, inertia of the moving parts, elasticity of the cord, friction of the pencil, the natural period of vibration of mechanism, and especially backlash, affect the accuracy of measurement in gas engine testing, an extent much greater than in steam engine work, owing to the much lower pressures in the latter case. Prof. Hopkinson's first care was to devise a satisfactory indicator.

"The author determined to get a new design of indicator of the piston and spring type with optical magnifying mechanism. In the form finally adopted, after a considerable amount of experimenting, the spring consists of a straight piece of steel strip held as an encastred beam in a steel frame. A piston slides in a bore communicating with the engine, the axis of this bore being at right angles to the spring and passing through its center. The pressure on the piston deflects the spring and so tilts a small mirror about an axis at right angles to the bore, the pivots of this mirror being carried on a steel frame. To give the other motion to the mirror the whole apparatus—

straight spring and mirror with its pivots—is positively connected to an eccentric on the crank axle by which it is rocked about the axis of the bore, thus giving the piston motion of the diagram without the possibility of any lost motion. This instrument is practically indestructible, and it has been left open to the engine for considerable periods without giving it any attention. The vertical deflection is accurately proportional to the pressure, so that the diagrams can be integrated with a planimeter. Finally, the period of oscillation is only about 1-700th of a second with such strengths of spring as were used in the mechanical efficiency tests. The indicator is very easily calibrated by dead weights. The diagrams used in these measurements were photographed, but for many purposes it has been found sufficient to observe them direct by means of a telescopic arrangement by which they are projected as a bright line of light on to a transparent screen with vertical and horizontal scales. It is easy to plot the diagram on to a piece of squared paper, and its area can thus be obtained within 5 per cent. without the trouble of photography."

Tests with this indicator established the fact that, "given a sufficiently accurate indicator and constant conditions, the indicated horse-power of a gas engine may be determined from diagrams with an accuracy which is probably superior to that attainable in the steam engine." Prof. Hopkinson emphasizes the necessity for keeping conditions constant in making tests and shows the effect of changes in pressure outside the cylinder and of changes in the temperature of the cylinder walls and piston on the accuracy of the measurement of indicated horse-power, outlining experiments undertaken to measure the extent of the effect produced by such changes.

POWER TRANSMISSION BY PRODUCER GAS.

A PROPOSAL FOR THE TRANSMISSION OF POWER GAS IN PIPE LINES FROM COAL MINES TO CENTRES OF INDUSTRIAL ACTIVITY.

Charles E. Lucke—Cassier's Magazine.

AN interesting discussion of the practicability of transmitting power by producer gas is given by Prof. Charles E. Lucke in a recent number of *Cassier's Magazine*. The idea of locating large central producer plants in the vicinity of cities to supply power to local industries is not new, but Prof. Lucke goes a step farther and proposes that coal should be gasified at the mine and the gas transmitted in pipe lines to industrial centres. After reviewing the development of power transmission from such purely mechanical means as shafts, gears, etc., through hydraulic pressure to compressed air, Prof. Lucke says:

"During the period of evolution power transmission methods with their differentiation or adaptation to special situations, culminating in the compressed air system, electrical progress was very rapid, and electrical methods of transmitting power, by reason of their great economy, adaptability and freedom of limiting distances, compared with its forerunners, enabled it to completely outshadow all these competitors. Electrical power transmission is equally feasible through only a few feet or hundreds of miles, though, of course, with somewhat unequal losses, and may convey small amounts of energy or the enormous outputs of great waterfalls without difficulty. Electrical transmission, by reason of its good features, has brought the stored energy of human nature from waterfalls to industrial communities. It has likewise removed innumerable shafts and belts from our factories and shops, distributed or transmitted power of a central engine or plant to any point fixed or movable, as in cars or cranes, where work was to be done. So successful has been the applications of electrical apparatus to the transmission of power that among engineers it has come to be regarded as pre-eminently the best method of transmitting power; but no matter how good a machine or piece of apparatus may be, the history of engineering progress seems to indicate that some time and somewhere a better one will be found; if not better for all applications, certainly better for some. Engineering practice real-

ly consists in the process of differentiation, applying the principle that what is best in one place or time will not necessarily be so in another,' or that 'something new may always find a useful field if essentially good.'"

Dr. Lucke comments on the development of high-pressure, long-distance pipe lines for the transmission of natural gas in various sections of the United States. "What was intended to be a convenience for postponing the inevitable has proved to be a practical method of transmitting power not by the transmission of fluid pressure, but by the transmission of concentrated energy in the form of gas fuel in pipes. Compressed fuel gas may generate power precisely as dry cylinder expansion does with compressed air; but it may also generate several times more, by its combustion in the gas engine, the exhaust heat from which would serve to reheat the compressed gas before its expansion. The comparatively limited supply of natural gas has prevented such a proposition as the above as a commercial proposition becoming a matter of general interest. As, however, the power-gas producer has, under development and improvement, become as reliable and rugged a piece of apparatus as the average boiler, requiring labor no more skillful to handle, the possibility of this method of power transmission by producer gas generated from coal is a matter that at least requires investigation.

"The present method of transmitting power from the coal mine as an origin of energy involves, outside of the mine plant itself, coal-loading machinery, freight car transportation over railroad systems, coal unloaders and reloaders, and the ultimate combustion of the coal in boilers or producers. The gas producer is capable of transforming a fairly large percentage of the energy in the coal to stable fuel energy in producer gas, and the gas-engine driven compressor is capable of pumping this gas at any desired pressure through absolutely unlimited distances by means of relays of the same sort of machine along the line. The pipe line would thus become a substitute for the freight car, and might even be laid on the same right of way, and instead of delivering. intermittently carloads of coal, discharge continuously energy in the form of compressed combustible gas, this applying, however, only so much of the coal transportation as would be required for power or heat. This pipe line could be tapped at any point for fuel gas or for power, which could be sold by meter with equal facility to both large and small consumer, just as it is at present done with electricity, and with one point decidedly in favor of the pipe line. There is practically no chance of a break in a reasonably well laid pipe line situated, for example, on the right of way of a good railroad, and service might safely be guaranteed, whereas at the present time, by reason of atmospheric condition, it is impossible to guarantee continuity of service over high-tension electrical transmission lines.

"If the fuel energy in the gas under transmission be alone considered, and the possibility of obtaining work by its expansion before combustion, the weight of gas to be transmitted may be taken at almost 80 per cent. of the weight of coal per horsepower transmitted, which comparison gives directly data for comparing the cost of transmission of the gas in pipes with coal in cars. At one of the Pennsylvania mines, anthracite buckwheat, selling in New York for $2.40 per ton, is sold for 60 cents, or one-quarter as much, indicating that the cost and profits of transportation represented three times the cost of mining, and that if such gas could be piped for less than $1.80 per ton the proposition would be profitable. In transporting oil the pipe line has shown itself to be a successful competitor of the car, and the analogy suggests the possibility of working the coal mine without railroad connections at all, just as the isolated oil wells have worked. Mines too high up, too low down or too small for railrad spurs might easily install producers and feed the main railroad pipe-line, receiving compensation by meter just as the ultimate consumer pays.

"Not only does the gas producer in connection with the gas-engine driven compressor offer a means of possible economical power transmission from the coal mine to the consumer, but it offers, like electricity, a similarly attractive prospect for the mill or factory having many isolated buildings, where ordinarily electric transmission will be the only thing considered.

A central gas-producer plant, located convenient to the coal supply, may be arranged to furnish gas under its own blast pressure to any part of the mill where power is wanted and where it may be secured by the installation of a gas engine. The gas producer may then economically feed as many gas engines situated as close to the work as may be desired. There are many cases of group driving where this method would furnish power in just as convenient a form as electrical transmission systems, and in such cases this system will prove very much more economical, because there is a loss every time energy is transformed. In the case of electric-transmission systems, the rotary motion is converted into electrical energy at the dynamo with a loss, transmitted over lines with another loss, converted back into rotary motion at the motors with another loss. The gas engine, placed at the point of group drive, may replace the group driving motor with the elimination of all other losses, and may do so in a way infinitely better than could be accomplished by steam, because there is no pipe-line loss, and because the small gas engine for each individual group drive would have practically the same thermal efficiency as a main engine driving a central dynamo. Furthermore, many manufacturing plants require heat for some of their processes, and there is no more convenient form of heating than producer gas burners. They can be controlled to maintain temperatures varying only a few degrees by means of thermostatic variations, and the gas can be the same as used for the engine.

"It would appear, therefore, to be perfectly feasible to use producer gas as a means of power transmission both for short distances around factory plants or for long distances from coal mines to towns or cities, and the prospects of economical transmission are very good. It may be that practicable as such power transmission certainly is, it will not find economical application; but this possibility seems to be somewhat remote, and that such a method of transmitting power will find a place, situation or set of conditions where it can be usefully applied is almost certain."

ECONOMY OF POWER IN CRUSHING ORE.

A STATEMENT OF THE MORE IMPORTANT POWER LOSSES IN ORE CRUSHING AND THE PRINCIPLES ON WHICH GREATER ECONOMY IS TO BE ATTAINED.

Ernest A. Hersam—Mining and Scientific Press.

THE following abstract of an article on power economy in crushing ore, lately contributed to the *Mining and Scientific Press,* will prove of great interest to managers of mills and smelters. Power waste in crushing, while very large, is probably more difficult to locate and remedy than in any other operation connected with milling and smelting. Mr. Hersam's paper outlines the various ways in which power is consumed without doing useful work and his suggestions for improvement are of great practical interest.

"First among the general losses is the power lost as pure friction. Friction can be either in the machine, in the ore, or even, when regarded in a certain way, within the body of the single pieces of the ore itself, as a kind of plastic deformation. All these true frictional losses are encountered throughout. They extend from the shafting and belting, which convey power from the prime mover, to the ore itself at the moment of breaking. Thus, friction must be considered as unavoidable as any part of the work done, but it is a part that produces no desired effect, and first indicates a lack of economy, due to improper construction or imperfect conditions.

"The second cause of loss arises from power given out in vibration in the foundation and elsewhere around the machinery, in supports and hangers, and disappearing in many ways. This energy is scattered in every direction. Foundations themselves, in some cases, consume much power; and the constant vibration everywhere, from the ground up to the dust-covered cobwebs on distant rafters, all are taking power to maintain the motion. Vibrations of other kinds than this, through the air as well as through the foundation and supports, take away a small part of the energy constantly. Were other more trifling

losses to receive separate attention, there could be included sound waves, heat waves, air pulsations, and even light, electricity, and other forms of energy, resulting from an unstable position of the pieces of ore in the machine, or caused elsewhere, as by the jarring of supports and foundations. Such wasted forms of energy being in part the result of friction, and in part of impact, are found everywhere, where there is motion, from the shafting, bearings, and belting, to the mass of ore itself. For the most part, however, the losses occur within the ore that is undergoing crushing.

"Third among the general losses, is that due to the unavoidable deformation of the ore. This is not precisely a part of the general friction. It is work done in the interior of the unbroken fragments, and is over and above that work which should be necessary to overcome mere cohesion of the molecules in producing an actual rupture of the particles. It is the way in which much power generally goes; and although in many cases it is a loss that can be much reduced by taking advantage of the natural conditions, there is no hope of avoiding it entirely.

"Fourth among the general losses could be named that which results from producing dust or fine below the size sought. The extent to which this becomes serious depends upon the subsequent process of treatment. To a certain degree, the production of dust signifies actual work done, however fine the dust may be. It is often to be regarded as work done improperly, however, if not an entire waste of the power expended upon it.

"The friction of the machinery depends in general upon the construction of the machine and the condition in which it is kept. On the whole it is relatively a small part of the entire loss. Crushing machinery is not different from other kinds in principle; the same loss of power could occur in conveying motion for any purpose. The loss, however, would be increased two or three times by bad management or neglect, or correspondingly reduced by care and careful construction. Matters that should not escape attention, but that are neglected sometimes in regions remote from supplies and inspection, are: Protection of bearings from dust, the use of suitable lubricants and of proper belting, the alignment of shafting, the wear of gearing, and the care of bearing parts. Correct construction in the beginning often saves much cost in the end, but no construction can withstand ill use or neglect.

"There have been cases where a change of lubricants has reduced the loss of power 30 per cent., although conditions had been supposed correct before. The change of temperature between winter and summer has its influence, and though the power lost in this way is too variable to state definitely, it is important if lubricants are not suited to the climate and the season. Whenever a bearing is running hot, it represents power wasted. To run bearings even perceptibly warm, and particularly in cold places, is too costly to go unnoticed. When machinery is first started it does not run easily. This is influenced by the nature of the lubricants, the load, the condition of the belting, the dust, the duration of a previous period of idleness, and other factors. With good construction and management the power lost through friction in the machinery may be made less than 10 per cent. of that expended in other ways. It is a visible loss many times, and is one evident to the mechanic."

The loss of power among the ore particles is much greater, the actual loss which usually appears in some form of friction being multiplied by an improper use of a machine. It varies greatly with the speed of the machine and with different methods of feeding and operating. The two forms of pure friction and molecular friction or deformation are to be reckoned with.

Surface friction is always accompanied by strain and deformation below the surface and the consequent molecular rearrangement which manifests itself in heat consumes power. All such friction is lessened by a free discharge of the crushed ore as it becomes reduced to the size wanted, but this condition is difficult to obtain. "To crush ore, the masses must be retained between the approaching surfaces that administer the force; but while too great an amplitude in the motion of the pressure surfaces tends uselessly to compress the fragments, grinding these upon one another, and distributing the force in many directions, too little amplitude, on

the other hand, fails to do more than deform some of the particles, and failing to break these, it wastes whatever energy is so expended. In a reciprocating jaw-crusher, at each revolution, whatever the amplitude, the jaws are certain to come to rest against the elastic strain of ore. The power must suffer loss each time the pressure is applied and released. Thus the loss in working would be most reduced by having exactly the right amplitude for the quantity of ore retained between the jaws at any one time, and by having sufficient voids between the pieces to provide a place for the crushed particles to occupy as soon as produced. This can be done by making the size of the original pieces uniform and comes from sizing before crushing."

Under stress ore will attempt to adapt itself without breaking to new positions. It cannot be worked under pressure like a plastic material, but there is a tendency for it to do this and it is this quality which consumes power. In the amount of power consumed the time element plays an important part. With plenty of time many kinds of rock will bend under stress while a sharp blow will result in fracture. Knowledge of the power consumed by this viscosity is limited. All that can be said practically upon the subject is that "much additional total power is required in running slowly upon certain kinds of tough rock; but, on the other hand, brittle or highly elastic rocks show little compensation for the mechanical loss there is in high speed."

Another important form of deformation is elastic deformation in which the ore alters and then again regains its shape. The power retained in this way is given back again when the pressure is released, but it may be returned at such a time and in such directions as to be lost for all practical purposes. This loss of power through elasticity varies with different machines and with different speeds of operation. Rapidly acting machines are usually economical with regard to plastic deformation, but may or may not be so far as elastic deformation is concerned. Mr. Hersam gives a discussion of the relative economy of crushing devices in this connection and then passes to a consideration of the real work accomplished in crushing and the methods of measuring it, concluding thus:

"The attainment of fullest economy in crushing will be found in a speed that is sufficiently high for tough ore, an amplitude that is adequate for elastic ore, and from a moderation of both speed and amplitude for brittle ore. Whenever the reduction in size is intended to be great, the fine must be protected from further crushing either by water suspension, repeated sizing, or abundant opportunity for rearrangement of the compressed ore by the provision of interstitial space that accompanies uniform sizing. It depends upon producing the effect of crushing rather than of grinding, particularly upon coarse sizes; and of employing hard and non-elastic surfaces in contact with the ore. It demands solid foundations for machinery, care, cleanliness, and protection of bearings, tested lubricants, and the avoidance of all unnecessary irregularity of shape in high-speed running parts designed for the construction."

SCIENCE IN THE IRON AND STEEL INDUSTRIES.

A DISCUSSION OF THE COMMERCIAL VALUE OF CHEMISTRY IN IRON AND STEEL MANUFACTURE.

C. H. Risdale—Cleveland Institution of Engineers.

THE following abstract of the presidential address of Mr. C. H. Risdale before the Cleveland Institution of Engineers emphasizes the importance of chemistry in the commercial management of iron and steel works. As Mr. Risdale points out, the development of methods of production in the iron and steel industries along the lines of increased size of plant, rapidity of process and excellence of mechanical detail in the handling of materials has about reached its limit of economy and future cost reduction must depend upon less obvious refinements in the processes of manufacture, the successful accomplishment of which must depend, to a great extent, on the assistance of the chemist.

The dominant feature of chemistry is precision. All chemical combinations are in exact proportions—law, order, system, run through all, and must be observed in every little detail. This in laboratory practice alone renders analysis possible, and the nearer it is approached in manufacture the better. Works processes are essentially chemical operations on a large scale, and profit depends on the quantitative as well as the qualitative success of these. For instance, 1 per cent. less waste may mean all the difference between profit and loss. Is the attainment of right conditions made a *sine quâ non*, or are they over-ruled by interests adverse to them? Are the re-agents, viz., the materials, sufficiently pure and uniform for the purpose? Have the operators (those who control the system and conduct the working, the directors, managers, and men) sufficient chemical training, or the right attitude of mind to appreciate its full significance? Is the apparatus (the plant) designed for carrying out the reactions in the best possible way? In laboratory practice a chemist often rigs up his own apparatus, and though the manufacture of the plant is the engineer's special business, none the less the chemist should be called in to see that it fulfils chemical requirements. In certain branches of the engineering and chemical manufacture the degree of accuracy attained is very great, and corresponding advantage has been felt, but this has not yet been sufficiently regarded as a necessity in iron and steel manufacture, and most of the hindrances and difficulties met with here are due to the want of regularity and precision. It is to the little things that closer attention must be given. From how many items in the cost sheet can 2s. 6d. or 3s. a ton now be saved? Many—apart from materials—do not exceed 3s. or 4s. altogether. In recent years engineers have tried by sheer force to increase and thus cheapen production. By the free introduction of up-to-date machinery materials are handled on a large scale rapidly and cheaply, and manual labour has been very much replaced and reduced almost to a minimum. Probably in some directions this has been carried too far. Again, efforts have been made to improve the organisation of large concerns, and reduce management and other fixed charges by amalgamation. In present circumstances what item can be cut right out or reduced very largely? It seems clear that almost the only remaining prospect of economy and progress in future is a closer approach to the conditions of the laboratory, viz., finer working and greater regularity all through, and works must be reorganised more on these lines. Has not this an advantage, besides the sentimental, as compared with expenditure on fresh plant and machinery? Suppose that by remodelling a works with a 200,000 tons yearly output, at a cost of £100,000, 2s. 6d. or 3s. can be saved per ton, and orders taken at lower prices. The yearly interest and depreciation on the borrowed money will probably be £15,000, an additional burden of 1s. 6d. per ton (apart from maintenance) on the costs before profit can be made. But if successful other works will quickly do the same, and though the margin of advantage may vanish, the burden will remain.

In improvement from closer adherence to chemical requirements, in system and quality of work, orderly, exact habits, care, and the balance of departments, the utmost is got out of existing plants with little or no capital outlay. Also the qualities of mind developed in the staff and workmen will be still there ready for further advance—a valuable reserve when other firms become educated to the same pitch. Many outside circumstances which at first sight have no connection with chemistry become of great concern. For instance, trade customs, the arrangement of works, labour questions, etc.

In commercial management frequently materials of widely different qualities are bought for the same purpose, for instance, a number of good and poor cokes, and uniformity of the mixture used, depending on them being delivered *pro rata*, may be upset by irregular deliveries. Again, traffic questions, internal and external, trucks of old date being cleared out of the order required by uniformity to avoid demurrage, or being blocked through limited siding accommodation, are all factors. In transit much of the small material—consisting of ironstone, coke, and coal largely of shale, and of ore, limestone, lime, etc., of dry soil and other impurities—is shaken down to the bottom; samples from the tops generally show too good results. Yet how many

works have proper facilities for sampling them after they have been tipped, or for holding them back if found to be unsatisfactory. The general dislocating effects of stoppages and holidays are well known; as also the effects of rain through wet coke, ore, etc., on blast furnaces; wind on kilns, etc. These affect precision of working, and upset the smooth run. Manufacturers to be successful have always to be contriving not only "fool-proof," but (to coin a term) "chance-proof" methods, which will go smoothly amid all such occurrences.

In the second part of his address Mr. Risdale dwelt upon the sources and results of irregularities in the main sections of the industries. After dealing at length with the raw material supply he proceeded to show that while the producer of raw materials takes very little trouble to control scientifically and regularise his product, it is not so with the pig-iron maker. He takes a great deal of pains to avoid and counteract irregularities. Probably at all blast furnace plants which serve steel works, and at a great many which do not, the aid of chemists is enlisted, and materials are more or less watched and products tested. Mr. Risdale enumerated most of the improvements that have been adopted at blast furnaces to aid regular working.

Taking the founder, Mr. Risdale remarked that he expects the iron to flow well, so that the castings will be clean and sound, and of the right strength, etc. His irregularities in material are due largely to the custom, only slowly being overcome in this country, of buying pig by fracture and not by analysis. Founders do not use the chemist enough, and go too much by rule of thumb.

The steel-maker takes the iron a step further and makes a still more uniform product. He is no more exempt from irregularities than other men. Standing midway in the chain of industries, he is the butt of both ends, and has to bear the brunt of those originating with the producer of raw material and the iron-maker, as well as the exactions of the purchasers. These last expect every single piece—not every train or truck load as with raw material—to be right in quality, etc., and perfectly sound. No average is allowed. For finished sections the narrow limits of variation are exactly specified by engineers or standard associations, and it is in the makers' own hands to meet them. The customer expects the steel to stand whatever treatment he may choose. He simply condemns whatever does not suit him, and lays all faults on the steel-maker. Therefore in no branch of the iron and steel trades are more pains taken to guard against and overcome variation. Huge mixers are used, and chemists and inspectors employed freely, while all sorts of tests and checks are used at every stage.

The steel user starts with material as nearly as possible sound and good, which provided the mechanical and physical laws are not violated, may be worked up into good finished product. He does little or nothing to prevent any ills, yet he disclaims all responsibility for these, and often considers himself ill-used. The users rarely keep their own chemists, or anyone whose duty it is to see that the steel gets the treatment which suits it best. Perhaps the greatest crop of irregularities occur during heat treatment of the steel. Mr. Risdale dealt at length with the defects that show themselves in steel and how they should be treated.

In concluding, Mr. Risdale dealt with the need for standards not only for coal, ironstone, ores, etc., but also for minor things, such as lubricants, boiler composition, alloys, etc. The greatest curse of the industries is irregularity. The absence of standards permits untrue statements about them. If everything were bought and sold to well-defined standards much of the irregularity would be removed, and one could rely in buying on always getting for a given grade exactly the same quality of article. Then many of the fluctuations in price from competition of varying qualities would vanish, and markets be steadier. Standardisation of raw materials will have to come if progress is to be made with the further products. Then the relative responsibility of the different sections of the industries should be clearly decided. Mr. Risdale, in saying a few words about the works of chemists, suggested that there was needed an "institute of practically experienced chemists," to which no examination can admit but only ability proved in practical work over a long period.

THE ENGINEERING INDEX

THE KEYSTONE IN THE ARCH OF APPLIED SCIENCE

The following pages form a descriptive index to the important articles of permanent value published currently in about two hundred of the leading engineering journals of the world—in English, French, German, Dutch, Italian, and Spanish, together with the published transactions of important engineering societies in the principal countries. It will be observed that each index note gives the following essential information about every publication:

(1) The title of each article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,

(7) *We supply the articles themselves, if desired.*

The Index is conveniently classified into the larger divisions of engineering science, to the end that the busy engineer, superintendent or works manager may quickly turn to what concerns himself and his special branches of work. By this means it is possible within a few minutes' time each month to learn promptly of every important article, published anywhere in the world, upon the subjects claiming one's special interest.

The full text of every article referred to in the Index, together with all illustrations, can usually be supplied by us. See the "Explanatory Note" at the end, where also the full title of the principal journals indexed are given.

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Blackwell's Island.

The Manhattan Approach of the Blackwell's Island Bridge. Illustrated detailed description of the massive steel viaducts connecting the anchor spans with the city streets at grade. 3000 w. Eng Rec—Nov. 23, 1907. No. 88540.

Caissons.

Lowering a Large Pneumatic Caisson with Screw Rods. Illustrates and describes manner of building and lowering the caissons for the piers of the 4-track Schuylkill River Bridge, at Philadelphia. 700 w. Eng Rec—Nov. 23, 1907. No. 88539.

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Cantilever.

The New Homberg Bridge. Illustrated description of the largest structure of its kind in Germany. Joins Homberg and

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Ruhrort. Plates. 1200 w. Engr, Lond—Nov. 1, 1907. No. 88239 A.

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Compression Members.

The Compressive Member. Horace E. Horton. Comments and criticisms bearing on the Quebec bridge disaster. 3000 w. Ry & Engng Rev—Nov. 2, 1907. No. 88074.

The Lacing of Compression Members. C. T. Morris. Brief explanation of the theory and its application. Mathematical. 900 w. Eng News—Nov. 7, 1907. No. 88112.

Concrete.

Design for the Henry Hudson Memorial Bridge: A Concrete Rib Arch of 703 ft. Span. Illustrates and describes the design proposed, with editorial comment. 4000 w. Eng News—Nov. 21, 1907. No. 88505.

The New Bridge Over the Wissahickon at Philadelphia. J. A. Stewart. Illustrated description of the Walnut Lane bridge, and the method of construction. 1500 w. Sci Am—Nov. 30, 1907. No. 88593.

Design.

Bridges and the Art Commission. Montgomery Schuyler. Considers the attitude of the Commission in regard to the Henry Hudson Memorial, and the Connecting Railroad bridge across the East River at New York. Ills. 2500 w. Archt Rec—Dec., 1907. No. 88591 C.

Lift-Bridge.

New Cowing Lift Bridge at Jefferson St., Cleveland. Brief illustrated description. 600 w. Ir Trd Rev—Oct. 31, 1907. No. 88007.

Piers.

The Reconstruction of the Anchor Piers of the Poughkeepsie Bridge. Illustrates and describes work made necessary to endure heavier traffic. 2500 w. Eng Rec—Nov. 9, 1907. No. 88192.

Quebec.

The Phoenixville Testimony in the Quebec Bridge Inquiry. Gives the testimony of the Phoenix Bridge Co.'s engineers before the Canadian Government Commission, with editorial. 21500 w. Eng News—Nov. 28, 1907. No. 88618.

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Reinforced Concrete.

The Long Key Viaduct. William Mayo Venable. Illustrated description of a two-mile reinforced-concrete railway viaduct, 3500 w. Eng Rec—Nov. 23, 1907. No. 88537.

Empiricism and Error in Arch Design. Charles W. Comstock. Considers erroneous and unscientific statements relative to the design of reinforced-concrete arches. 3000 w. Eng News—Nov. 28, 1907. No. 88617.

Shearing Stresses.

Railroad Bridges with One Standard Gauge Track (Ponts de Chemins de Fer à une Travée et à Voie Normale). E. Pentecôte. An algebraic determination of the maximum shearing stress on the bearings and at the centre of the principal girders, and of the zone of alternating shearing stresses for a certain standard rolling load. Ills. 5000 w. Rev Gén des Chemins de Fer—Oct., 1907. No. 88317 G.

Steel Truss.

Bridge of Chicago & Northwestern, Pierre, S. D. Illustrates and describes a new bridge across the Missouri River. 600 w. Ry Age—Nov. 1, 1907. No. 88073.

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The Hinged Type of Suspension Bridge with Stiffening Girders (Pont Suspendu à Poutres Raidissantes et à Articulation Médiane). M. Gisclard. An elaborate discussion of the superiority of the hinged over the rigid type of stiffened truss, using as illustration the Brooklyn Bridge. Ill. 18000 w. Ann d Ponts et Chauss—1907—III. No. 88306 E + F.

Swing Bridges.

Two Unique Electrically Operated Australian Swing-Bridges. Illustrations with short description of two bridges at Sydney. 1000 w. Elec Rev, N Y—Nov. 23, 1907. No. 88515.

Trestles.

Wooden Railway Trestles. R. Balfour. A critical discussion of the design and construction. Ills. 2500 w. Can Engr—Nov. 1, 1907. No. 88005.

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Continuous Beams. A. W. Connor. Gives a few applications of the theory to problems. 900 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88134 N.

The Vierendeel System for Long-Span Reinforced-Concrete Beams (Eisenbetonträger für grosse Spannweiten, System Vierendeel). A mathematical discussion. Ills. 2500 w. Seriál. 1st part. Beton u Eisen—Oct., 1907. No. 88354 F.

Buildings.

On the Influence of the Use of Iron and Steel on Modern Architectural Design. Victor D. Horsburgh. Considers the present use of these materials, their influence, and states the conclusions reached. 9000 w. Jour Roy Inst of Brit Archts—Oct. 19, 1907. No. 88268 B.

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Caissons.

Some Notes on Pneumatic Caissons for Bridges and Buildings. T. Kennard Thomson. An illustrated description of caissons and methods of using them, with related matters. 4000 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88120 N.

Cellars.

Water-Proof Cellar Construction. Colbert A. MacClure. Considers the "tar and felt" and the "hydrolithic" cement systems. Discussion. 10000 w. Pro Engrs' Soc of W Penn—Nov., 1907. No. 88527 D.

Coal Pocket.

A Modern Retail Coal Pocket. Charles J. Steffens. Illustrated description of the arrangement of conveying machinery and coal pockets at a Hoboken, N. J., plant. 2200 w. Eng Rec—Nov. 2, 1907. No. 88048.

Concrete Blocks.

Cost of Molding and Laying Concrete Blocks for a Factory Building. Information in regard to factory buildings at Grand Rapids, Mich. 1000 w. Engng-Con—Nov. 6, 1907. No. 88149.

Dams.

See same title under WATER SUPPLY.

Docks.

See same title under WATERWAYS AND HARBORS.

Excavation.

Methods and Costs of Excavating Granite in Open Cuts on the Grand Trunk Pacific R. R. 4500 w. Engng-Con—Nov. 27, 1907. No. 88610.

Factories.

Advances in Factory Construction. L. P. Alford. Showing growth in reinforced concrete construction and other details. Ills. 2500 w. Am Mach—Vol. 30, No. 45. No. 88173.

Reinforced Concrete in Factory Construction. Frederick A. Waldron. Gives direct cost and structural comparisons between mill, steel and reinforced-concrete factory buildings. Ills. 2500 w. Am Mach—Vol. 30, No. 45. No. 88170.

The New Leipzig Cotton Mill in Leipzig-Lindenau (Neue Leipziger Baumwollspinnerei in Leipzig-Lindenau). Em. Haimovici. An illustrated description of the design and construction of this reinforced-concrete factory building. Plate. 2200 w. Beton u Eisen—Oct., 1907. No. 88356 F.

See also Concrete Blocks, under CONSTRUCTION.

Foundations.

Heavy Foundations for the New Steel Works at Gary, Ind. Illustrates and describes the plant and methods used in the construction. 4000 w. Eng Rec—Nov. 2, 1907. No. 88046.

A Consideration of the Earth's Surface in Its Relation to Building Construction. Owen B. Maginnis. Considers the ingredients that compose the earth's crust in relation to foundation work in building. 1700 w. Archts & Bldrs' Mag—Nov., 1907. No. 88536 C.

Governor's Island.

The Enlargement and Reconstruction of Governor's Island. Illustration, with brief account of plans to enlarge the island by 101 acres, reclaimed by means of sea walls and dredging, and other changes. 1200 w. Sci Am—Nov. 30, 1907. No. 88594.

Piers.

See same title under WATERWAYS AND HARBORS.

Pier Shed.

Reconstructing a New York Pier Shed. The work on Pier 36, North River, is illustrated and described. 1000 w. Eng Rec—Nov. 2, 1907. No. 88049.

Piles.

See Concrete Piles, under MATERIALS OF CONSTRUCTION.

Reclamation Work.

Land Reclamation in Holland. An account of past and present work. 2500 w. Engr, Lond—Nov. 15, 1907. Serial. 1st part. No. 88587 A.

See also Governor's Island, under CONSTRUCTION.

Regulations.

New Reinforced Concrete Regulations in Philadelphia. Regulations approved by the Bureau of Building Inspection on Oct. 8. 2800 w. Eng Rec—Nov. 2, 1907. No. 88047.

Reinforced-Concrete Building Laws; Their Differences and Deficiencies. H. C. Hutchins. A comparison and criticism of the chief established codes. Ills. 5000 w. Engineering Magazine—Dec., 1907. No. 88624 B.

Reinforced Concrete.

A Ten-Story Reinforced Concrete Building. Illustrated description of a warehouse in Pittsburg. 2200 w. Eng News—Nov. 7, 1907. No. 88113.

Method and Cost of Building a Reinforced Concrete Garage. Illustrated general description with itemized costs. 1100 w. Engng-Con—Oct. 30, 1907. No. 88034.

A Concrete Building for a Chocolate Factory. Illustrated description of a structure at Stamford, Conn., with reinforced-concrete saw-toothed roof and framework, and cement-block walls. 2000 w. Eng Rec—Nov. 9, 1907. No. 88193.

Test of Reinforced-Concrete Roof. J. Ernest Franck. Illustrations, with account of test of the Borough of Hammersmith Public Baths and Wash-Houses, and the reasons for using reinforced con-

We supply copies of these articles. See page 715.

crete. 2000 w. Jour Roy Inst of Brit Archts—Oct. 19, 1907. No. 88269 B.

Faults of Reinforced Concrete Design and Construction. H. F. Porter. Discusses causes of failure, and gives recommendations for securing successful work. 2500 w. Engng-Con—Nov. 13, 1907. No. 88266.

See also Beams, Factories, and Regulations, under CONSTRUCTION; Sewers, under MUNICIPAL; Reservoirs and Water Towers, under WATER SUPPLY; and Pier, under WATERWAYS AND HARBORS.

Reservoirs.

See Reservoirs and Water Towers, under WATER SUPPLY.

Roofs.

See Reinforced Concrete, under CONSTRUCTION.

Singer Building.

The Structural Features of the Singer Building, New York. Illustrated detailed description. 3500 w. Eng Rec—Nov. 16, 1907. No. 88405.

Stacks.

The World's Greatest Stack. W. C. Capron. Illustrated account of a stack in course of construction at Great Falls, Montana. 1000 w. Sib Jour of Engng—Nov., 1907. No. 88489 D.

Steel Buildings.

Modern Steel Buildings. John M. Ewen. On the construction and also the methods of business organization necessary for rapid and efficient work. Ills. 6000 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88127 N.

The German-American Insurance Building, New York. Illustrates and describes interesting details of a 20-story steel-cage structure in New York City. 2000 w. Eng Rec—Nov. 9, 1907. No. 88196.

The Largest Single Office Building in the World. Illustration of the 33-story structure of the City Investment Company in New York, with descriptive notes. 1000 w. Sci Am—Nov. 23, 1907. No. 88500.

Erecting a Heavy Steel Building with Jinniwinks. The conditions in connection with the extension work on the Lincoln Wharf power house, Boston, are explained, and the methods adopted. 1400 w. Eng Rec—Nov. 2, 1907. No. 88053.

See also Buildings and Singer Building, under CONSTRUCTION.

Syphon.

See same title under WATER SUPPLY.

Tunnels.

The Tunnels Under the North and East Rivers. William Yale. Short illustrated account of the 12 tunnels under construction, the methods and information of interest. 1800 w. Yale Sci M—Nov., 1907. No. 88413 C.

New Boring Machines for Tunneling. Discusses the claims and defects of several newly invented rock-boring machines. 2000 w. Eng & Min Jour—Nov. 23, 1907. No. 88544.

Construction Methods in the Second Bergen Hill Tunnel of the Lackawanna R. R. Describes work in progress in New Jersey. 2500 w. Eng Rec—Nov. 9, 1907. No. 88198.

The Mechanical Plant for the Construction of the Tauern Tunnel in Austria. Notes from a paper by Karl Brabbée, before the Soc. of Austrian Engs. & Archts. Outlines the work and describes the installation of machinery. 2500 w. Eng Rec—Nov. 2, 1907. No. 88050.

The Construction of the Gattico Tunnel (Les Travaux du Tunnel de Gattico). An illustrated description. 3000 w. Génie Civil—Oct. 5, 1907. No. 88325 D.

See also same title under WATER SUPPLY.

Waterproofing.

See Cellars, under CONSTRUCTION.

MATERIALS OF CONSTRUCTION.

Cast Iron.

Tests of Cast Iron Beams. Elmer H. Fish. Brief account of tests made and results. 1200 w. Jour Worcester Poly Inst—Nov., 1907. No. 88261 C.

Cement.

Classification and Uses of Cement. Samuel S. Sadtler. Considers the phenomena of setting, composition, cost and details of use. 2800 w. Jour Fr Inst—Nov., 1907. No. 88254 D.

The Cement Industry and Consumers (L'Industrie des Cements et des Chaux Hydrauliques devant les Consommateurs). Henry Le Chatelier. A discussion of the attitude of consumers to the cement industry in France, the need for standards of composition, tests, etc. 7000 w. Rev de Métal—Oct., 1907. No. 88314 E + F.

Cement Testing.

Some Problems of a Cement Inspecting Laboratory. R. S. Greenman. Discusses problems of a laboratory which inspects cement proposed for use on work. 1800 w. Cement Age—Nov., 1907. No. 88215.

Concrete.

The Action of Sea Water on Concrete. From report of a committee of the Supts. of Bridges and Buildings Assn., giving opinions from replies to a circular letter. 1500 w. R R Gaz—Nov. 8, 1907. No. 88158.

Concrete Piles.

The Simplex System of Concrete Piling. Thomas McKellar. An illustrated detailed description of this method. 3800 w. Jour Assn of Engng Socs—Oct., 1907. No. 88493 C.

We supply copies of these articles. See page 715.

Concrete Piles. Charles R. Gow. An account of methods of construction used, with reasons for their adoption. Ills. 4000 w. Jour Assn of Engng Socs—Oct., 1907. No. 88492 C.

Paints.

Rust Prevention. L. M. Stern. (Abstract.) A treatise on the preservation of iron and steel by paint. 6500 w. Ir Age—Nov. 21, 1907. Serial. 1st part. No. 88509.

Reinforced Concrete.

Compression Tests of the French Government Commission. Reports tests made of 12 reinforced-concrete prisms. Ills. 2800 w. Cement—Oct., 1907. No. 88210 C.

Timber Preservation.

Requirements for Treating Wood Paving Blocks. George W. Tillson. Discusses the proper treatment to prevent natural decay and maintain stability in size. 3300 w. Munic Engng—Nov., 1907. No. 88030 C.

Forestry and the Preservation of Wood. Charles E. Koons, Sr. Quotes from reports of the U. S. Forestry Dept. and briefly considers processes in use for wood preservation. 3500 w. Pro St Louis Ry Club—Nov. 8, 1907. No. 88621.

See also same title, under MINING AND METALLURGY, MINING.

MEASUREMENT.

Surveying.

See Surveying, under MINING AND METALLURGY, MINING; and Surveying, under RAILWAY ENGINEERING, NEW PROJECTS.

MUNICIPAL.

Garbage Disposal.

A Project for a Garbage Burning Plant with Drying and Mud-Separating Devices for Pforzheim City (Projek einer Müllverbrennungsanstalt mit Klärschlammtrocknungsanlage für die Stadt Pforzheim). Herrn. Herzberger and Morave. Ills. 7300 w. Gesundheits-Ing—Oct. 5, 1907. No. 88358 D.

Gary, Ind.

Water Supply and Sewerage of the New Industrial Town of Gary, Ind. Describes the water supply, taken from Lake Michigan, and the combined system of sewerage disposal adopted. 2000 w. Eng News—Nov. 7, 1907. No. 88114.

Pavement Repair.

Municipal Paving Repair Plant. An illustrated account of a plant in operation at New Orleans, La., with details of cost and other data. 3800 w. Munic Jour & Engr—Nov. 6, 1907. No. 88152 C.

Pavements.

See Timber Preservation, under MATERIALS OF CONSTRUCTION.

Roads.

Road Hardening and Dust Prevention about Boston. Reviews papers on this subject read at meeting of the Massachusetts Highway Association. 4000 w. Eng Rec—Nov. 23, 1907. No. 88541.

Rescuing Our Roads. George Ethelbert Walsh. Discusses the road problem, describing the manner in which it has been solved in certain localities. 2500 w. Sci Am—Nov. 9, 1907. No. 88159.

Bridle Roads in the West Indies. H. C. Huggins. Pertaining to the methods of construction and maintenance of natural-soil hillside bridle roads. 4 Plates. 3000 w. Soc of Engrs—Nov. 4, 1907. No. 88487 N.

Sewage Disposal.

Colwyn Bay Sewage Works. Brief illustrated description of the scheme to clear the sea front from contamination. 1500 w. Engr, Lond—Nov. 1, 1907. No. 88237 A.

Sewage Disposal Plant of Reading, Pa. Illustrates and describes the apparatus for screening and pumping, the septic tank, sprinkling filters, sedimentation basin, &c. 3500 w. Munic Jour & Engr—Nov. 6, 1907. No. 88151 C.

Report on Sewage Disposal of the Calumet District Through the Chicago Drainage Canal. Gives report of Rudolph Hering on the relative advantages of disposing of the Calumet District sewage by dilution through the drainage canal and by sprinkling filters. 2200 w. Eng News—Nov. 7, 1907. No. 88116.

See also Gary, Ind., under MUNICIPAL; and Pumping Plants, under MECHANICAL ENGINEERING, HYDRAULICS.

Sewage Filters.

Studies of Sewage Distributors for Trickling Filters. C.-E. A. Winslow, Earle B. Phelps, C. F. Story, and H. C. McRae. The general problem, methods of measuring, calculating efficiency, &c., are considered. Ills. 12000 w. Tech Qr—Sept., 1907. No. 88077 E.

Sewage Sterilization.

The Sterilization of Treated Sewage. Gives an outline of investigations described in a recent bulletin of the U. S. Bureau of Plant Industry. 4500 w. Eng Rec—Nov. 16, 1907. No. 88409.

Sewer Discharges.

A Short Method of Recomputing Sewer Discharges for a Changed Value of n in Kutter's Formula. An explanation of the method evolved. 800 w. Eng News—Nov. 21, 1907. No. 88504.

Sewers.

Reinforced Concrete Sewers in Staten Island. Detailed description, with illustrations. 2800 w. Eng Rec—Nov. 2, 1907. No. 88052.

Trenches.

Back Filling Trenches. George C. War-

ren. Considers the importance of and suggests practicable methods for overcoming the difficulties. 3300 w. Munic Enging—Nov., 1907. No. 88031 C.

WATER SUPPLY.

Air Valves.

Improvised Air Valves for Water Lines. Frank Martin. Illustrates and describes a float valve and its working. 800 w. Power—Nov., 1907. No. 88014 C.

Artesian Wells.

Camden's Artesian Water Supply Is Not Derived from the Delaware River by Infiltration. Prof. Oscar C. S. Carter. Explains reasons for the author's opinions. Ills. 4000 w. Jour Fr Inst—Nov., 1907. No. 88253 D.

The Artesian Water Supply of Australia. C. O. Burge. Information in regard to the artesian area, the quality and possible uses of the water. 2000 w. Eng Rec—Nov. 16, 1907. No. 88411.

Australia.

See Artesian Wells, under WATER SUPPLY.

Dams.

The Hauser Lake Steel Dam in the Missouri River, near Helena, Mont. Illustrated detailed description of an interesting structure. 1300 w. Eng News—Nov. 14, 1907. No. 88553.

Methods and Cost of Making Two Hydraulic Fill Dams. An illustrated article, giving data and information of the building of the earthwork. 3000 w. Engng-Con—Nov. 13, 1907. No. 88267.

See also Tarare, France, under WATER SUPPLY.

Filtration.

Report on the Filtration of the Croton Water Supply, New York City. With editorial. 4000 w. Eng News—Nov. 21, 1907. No. 88506.

The Filtration of the Croton Water Supply of New York. Plan, sections, and description of the proposed filter plant. 4000 w. Eng Rec—Nov. 23, 1907. No. 88538.

Sand Filtration of Water Supply. Andrew Williamson. The present number gives an account of the construction of modern sand filters. Later articles will review the working practice. 4500 w. Engng—Nov. 1, 1907. Serial. 1st part. No. 88234 A.

See also under Springfield, Mass., under WATER SUPPLY.

Gary, Ind.

See same title, under MUNICIPAL.

Irrigation.

Distribution of Irrigation Water from Canals in the Yakima Valley, Washington. S. O. Jayne. Information from Bul. 188, U. S. Dept. of Agriculture, describing the work. 3500 w. Eng News—Nov. 7, 1907. No. 88117.

The Irrigation Canal from the Hérault and the Projects for Canals from the Rhone (Le Canal d'Irrigation Dérivé de l'Hérault et les Projets de Canaux Dérivé du Rhone). Francis Marre. An account of irrigation projects in the wine districts of Southern France. Ills. 3000 w. Génie Civil—Oct. 5, 1907. No. 88326 D.

Orifices.

The Discharge of a Circular Orifice (Débit d'un Orifice Circulaire). Casimir Monteil. A mathematical investigation of the degree of approximation obtained by the formula commonly used by engineers. Ills. 6000 w. Ann d Ponts et Chauss—1907, III. No. 88310 E + F.

Pipe Lines.

The Fundamental Principles in the Design of Pipe Lines (Grundlagen für die Berechnung der Wasserleitungen). Eduard Sonne. A mathematical review of hydraulic principles. Ills. 6600 w. Zeitschr d Ver Deutscher Ing—Oct. 12, 1907. No. 88363 D.

See also Corrosion, under ELECTRICAL ENGINEERING, ELECTRO-CHEMISTRY.

Pollution.

See Stream Pollution, under WATER SUPPLY.

Pumping.

See same title, under MECHANICAL ENGINEERING, HYDRAULICS,

Purification.

Removal of Manganese from Deep Well Water. Trans. from *Jour. für Gasbeleuchtung und Wasserversorgung.* Describes an interesting experience in the water supply of Arad, in Hungary. 1100 w. Eng Rec—Nov. 9, 1907. No. 88197.

See also Filtration, under WATER SUPPLY.

Rand.

The Rand Water Board Plant and Works. An illustrated series of articles giving information in regard to the public water supply. 2500 w. Engr, Lond—Nov. 1, 1907. Serial. 1st part. No. 88236 A.

Reservoirs.

Method and Cost of Building a Reinforced Concrete Reservoir. General description, with itemized costs. 2500 w. Enging Con—Nov. 6, 1907. No. 88148.

See also Tarare, France, and Water Towers, under WATER SUPPLY.

Springfield, Mass.

The Springfield Water Works. Elbert E. Lochridge. An account of troubles with the Ludlow water and the filtration system; also other features of the new supply. Ills. Discussion. 9000 w. Jour N Eng W Wks Assn—Sept., 1907. No. 88598 F.

We supply copies of these articles. See page 715.

Statistics.

Water Works Statistics for the Year 1906, in Form Adopted by the New England Water Works Association. Compiled by Charles W. Sherman. 2500 w. Jour N. Eng W Wks Assn—Sept., 1907. No. 88596 F.

Stream Pollution.

State Protection of the Purity of Inland Waters. R. Winthrop Pratt. Discusses laws for securing pure water supplies and unpolluted streams in connection with the work of the State health departments. General discussion follows. 11700 w. Jour Assn of Engng Soc—Oct., 1907. No. 88490 C.

The Prevention of Stream Pollution by Strawboard Waste. Earle Bernard Phelps. Describes the manufacture of strawboard, discussing the problem of the disposal of the waste liquor, giving laboratory and field investigations, and treatment recommended. Ills. 9000 w. Tech Qr—Sept., 1907. No. 88076 E.

Water Pollution in the Oswego and Upper Hudson River Drainage Areas. Extracts from recent reports of the N. Y. State Dept. of Health. 2500 w. Eng News—Nov. 7, 1907. No. 88110

Syphon.

The Construction of a Syphon in Upper Egypt. E. Neuhaus. Illustrated detailed description of the construction of a syphon consisting of mild-steel pipes, with heads and wings in masonry. 4000 w. Engr, Lond—Oct. 25, 1907. No. 88108 A.

Tarare, France.

The Water Supply of the City of Tarare (Ville de Tarare—Alimentation en Eau Industrielle). M. Pascalon. A brief description of the dam, reservoir, etc., for the supply of water from the River Turdine. 2500 w. Ann d Ponts et Chauss—1907, III. No. 88307 E + F.

Tunnels.

New Water Supply Tunnels at Chicago. Illustrates and describes recent additions to the tunnel system for the purpose of improving the water supply of the southern portion of the city. 3500 w. Eng News—Nov. 14, 1907. No. 88554.

Water Meters.

A Note on Water Meters (Note sur les Compteurs d'Eau). M. Dariès. Deals mathematically with the general design of the disc type and illustrates and describes all the leading devices. 22000 w. Rev de Mécan—Sept. 30, 1907. No. 88318 E + F.

Water Towers.

Note on the Design of Cylindrical Reservoirs (Beitrag zur Berechnung Zylindrischer Reservoire). Emil Reich. A mathematical discussion. 2000 w. Beton u Eisen—Oct., 1907. No. 88355 F.

The Hard-Fussach Water Tower (Der Wasserturm in Hard-Fussach). Mich. Heimbach. Illustrated description of the design and construction of this reinforced-concrete structure for the storage of drinking water. 1500 w. Beton u Eisen—Oct., 1907. No. 88353 F.

WATERWAYS AND HARBORS.

Barge Canal.

The New York Barge Canal. Lindell Theodore Bates. A review of past history of the Erie Canal and an illustrated description of the character of the work in progress. 2000 w. Yale Sci M—Nov., 1907. No. 88412 C.

Bruges.

Bruges Harbor (Der Seehafen von Brügge). Illustrated description of the new harbor works and ship canal. 1600 w. Serial, 1st part. Deutsche Bau—Oct. 26, 1907. No. 88344 D.

Canal Gradients.

The Effect of Changes in Canal Grades on the Rate of Flow. F. W. Hanna. Derives a surface curve formula based on Bresse's tables that will have general application. 1800 w. Eng News—Nov. 21, 1907. No. 88503.

Canals.

See Barge Canal, Bruges, Great Britain, Panama Canal, and U. S. Waterways, under WATERWAYS AND HARBORS.

Docks.

First Steel Ore Docks on the Great Lakes. Describes the steel dock being built at Two Harbors, Minnesota. 2500 w. Ir Trd Rev—Nov. 28, 1907. No. 88606.

The Proposed Dock System of Newark. Plan and brief description of proposed dock and canal system for improving the shipping facilities. 1200 w. Eng Rec—Nov. 16, 1907. No. 88410.

Dredges.

The Dredger "Affonso Penna." Illustrated description of a dredge built for work at the foot of Rio de Janeiro, Brazil. 1000 w. Engng—Oct. 25, 1907. No. 88100 A.

French Ports.

The Projects for the Improvements of French Ports (Les Projets de Réforme du Régime des Ports Français). P. Maurice. The first instalment commences a discussion of the inferiority of French ports and the possible remedies. Ills. 2400 w. Serial. 1st part. Génie Civil—Oct. 19, 1907. No. 88330 D.

Genes Harbor.

The Visit of the Association of Bridge, Highway and Mining Engineers to Gênes Harbor (Visite de l'Association des Ingénieurs des Ponts et Chaussées et des Mines au Port de Gênes). M. Voisin. Describes projected enlargements and

improvements. Plates. 6000 w. Ann d Ponts et Chauss—1907, III. No. 88308 E + F.

Great Britain.

Navigable Waterways of Great Britain and Ireland (Voies Navigables de la Grande Bretagne et d'Irelande). Quinette de Rochemont. Gives a review of past and present conditions, with a complete table of financial, technical and traffic details of all the canals in Great Britain and Ireland. 12000 w. Ann d Ponts et Chauss—1907, III. No. 88305 E + F.

Harbor Improvements.

Harbor Works at the Beginning of the Twentieth Century (Le Costruzioni Marittime al Principio del XX° Secolo). Luigi Luiggi. Describes modern types of breakwaters, docks, etc., and discusses the most suitable forms for proposed extensive improvements in Italian harbors. 10500 w. Ann d Soc d Ing e d Arch Ital —XXII., No. 6-7. No. 88301 F.

Italian Harbors.

See Harbor Improvements, under WATERWAYS AND HARBORS.

Newark, N. J.

See Docks, under WATERWAYS AND HARBORS.

Panama Canal.

Annual Report of the Isthmian Canal Commission to the Secretary of War. Condensed Report, with illustrations. 10700 w. Eng News—Nov. 28, 1907. No. 88616.

Pier.

The Great Government Pier at the Jamestown Exposition. E. Dabney Lunis. Illustrations, with brief notes on its construction. 500 w. Sci Am Sup—Nov. 9, 1907. No. 88162.

Shore Protection.

See Reclamation Work, under CIVIL ENGINEERING, CONSTRUCTION.

South America.

Water Power Possibilities in South America. Lewis R. Freeman. An illustrated article showing the ideal conditions for hydro-electric plants. 2300 w. Power —Nov., 1907. No. 88016.

Stream Flow.

The Equations of the Empirical Laws of Stream Flow (Les Equations des Lois Empiriques de l'Hydraulique Fluviale). M. Fargue. A mathematical discussion of the relation between the windings of rivers and their depths. Ills. 6000 w. Ann d Ponts et Chauss—1907, III. No. 88309 E + F.

U. S. Waterways.

The Revival of Internal Waterways in the United States. George Ethelbert Walsh. Calls attention to the natural system of waterways in the United States, and discusses proposed canal developments and river improvements. 3000 w. Cassier's Mag—Oct., 1907. No. 87387 B.

Water Powers.

I. Computation of the Values of Water Powers, and the Damage Caused by the Diversion of Water Used for Power. Charles T. Main. II. Damage Caused by the Diversion of Water Power. Clemens Herschel. III. Water Rights. Richard A. Hale. Three papers discussed together. 20700 w. Jour N Eng W-Wks Assn—Sept., 1907. No. 88597 F.

ELECTRICAL ENGINEERING

COMMUNICATION.

Radio-Telegraphy.

The Clifden Station of the Marconi Wireless Telegraph System. Illustrated description of this station in Ireland. 600 w. Sci Am—Nov. 23, 1907. No. 88499.

Regular Wireless Service Between America and Europe. Reginald A. Fessenden. A letter correcting misstatements which have been published in the daily press. 4000 w. Sci Am Sup—Nov. 16, 1907. No. 88246.

The Naval Wireless Telegraph Station at Sitka, Alaska. H. C. Gearing. General information relating to coast stations, with illustrated description of station named. 1600 w. Elec Wld—Nov. 16. 1907. No. 88433.

Some Observations on the Poulsen Arc. J. A. Fleming. A paper read before the Physical Soc., London. A record of observations in connection with a study of the arc method of exciting oscillations. 4200 w. Elec Rev, N Y—Nov. 9, 1907. No. 88199.

Telephone Cables.

The Pupin Telephone Cable, with Self-Induction Coils, Laid by Siemens and Halske Co. in the Bodensee (Ueber das von der Siemens & Halske A.-G. in Bodensee verlegte Fernsprechkabel, mit Selbstinduktionsspulen nach dem Pupinschen System). Illustrated description of manufacture and laying of the cable. 2000 w. Elektrotech u Maschinenbau—Oct. 6, 1907. No. 88321 D.

Telephony.

Power Work as Related to Telephone Communications. Thomas Lambert. Explanation of the requirements of the ser-

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vice and the importance of the power plant. General discussion. 7000 w. Jour W Soc of Engrs—Oct., 1907. No. 88523 D.

Telephotography.

Electrical Transmission of Pictures. Illustrated description of the apparatus devised by Dr. Arthur Korn. 1000 w. Elect'n, Lond—Nov. 8, 1907. No. 88470 A.

DISTRIBUTION.

Current Rectifiers.

Characteristics of Circuits Employing a Mercury Arc Rectifier. O. S. Beyer and A. J. Loppin. A report of recent investigations and results. Diagrams. 800 w. Stevens Ind—Nov., 1907. No. 88218 D.

Insulation.

Some Notes on Insulation and Insulation Testing. S. M. Hills and T. Germann. (Abstract.) Considers the requirements of good insulators, and the importance of testing. 1000 w. Elec Engr, Lond—Nov. 8, 1907. No. 88466 A.

See also same title, under TRANSMISSION.

Switches.

Circuit-Interrupting Devices. F. W. Harris. The first of a series of important articles on the design, application and operation. 1800 w. Elec Jour—Nov., 1907. Serial, 1st part. No. 88080.

Wiring.

Wiring with Iron Conduit. Louis J. Auerbacher. Treats only of the unlined conduit, illustrating and describing methods of installing. 1600 w. Elec Wld—Nov. 2, 1907. No. 88061.

DYNAMOS AND MOTORS.

Alternators.

Distribution and Breadth Coefficients of Alternators. N. Stahl. Mathematical. Gives formulae, with explanation. 1200 w. Elec Wld—Nov. 9, 1907. No. 88190.

See also same title, under GENERATING STATIONS.

Asynchronous.

The Separation of the Losses in Asynchronous Machines (Zur Trennung der Verluste in Asynchron Maschinen). W. Linke. A theoretical and mathematical discussion. Ills. 3200 w. Elektrotech Zeitschr—Oct. 3, 1907. No. 88368 D.

Brushes.

Experiments on the Identification of Carbon Brushes for Dynamos (Essais ayant pour But l'Identification des Balais de Charbon pour Dynamos). The results of an elaborate series of tests to establish means of determining the properties of carbon brushes for ease in identification of a suitable material when replacements are necessary. Ills. 12000 w. Bul Soc Int d Elecns—Aug., Sept., Oct., 1907. No. 88315 F.

Commutation.

The Neutral Line of the Cummutator Cylinder (Zur näheren Erläuterung der neutralen Kommutierungszone). C. L. R. E. Menges. An endeavor to clear up certain obscure points. Ills. 4500 w. Elektrotech Zeitschr—Oct. 31, 1907. No. 88376 D.

Commutator.

What Is a Commutator? George S. Hodgins. An explanation. 1500 w. Ry & Loc Engng—Nov., 1907. No. 88002 C.

D. C. Dynamos.

The First American Gramme Ring Dynamo. G. S. Moler. Illustration, with brief account of a dynamo built in 1875. 1000 w. Sib Jour of Engng—Nov., 1907. No. 88488 D.

D. C. Motors.

Direct-Current Motors, Their Action and Control. F. B. Crocker and M. Arendt. The present article deals with the general principles of these motors. In succeeding articles various types of motors and methods of control will be considered in detail. 3000 w. Elec Wld—Nov. 2, 1907. Serial, 1st part. No. 88059.

The Starting, Regulating and Stopping of Continuous-Current Motors. J. T. Mould. Abstract of a paper read before the Assn. of Engrs.-in-Charge. Briefly considers methods of control. 2500 w. Elect'n, Lond—Nov. 8, 1907. No. 88471 A.

D. C. Turbo-Generators.

Direct-Current Turbo-Generators. H. I. C. Beyer. Outlines the constructive features of such machines, giving solutions of many electrical and mechanical problems involved. Ills. 3500 w. Elec Wld—Nov. 16, 1907. No. 88431.

Electric Power.

See Electric Driving, under MECHANICAL ENGINEERING, POWER AND TRANSMISSION.

Large Generators.

Discussion on "The Practicability of Large Generators Wound for 22,000 Volts," at New York, March 22, 1907. 7500 w. Pro Am Inst of Elec Engrs—Oct., 1907. No. 88259 D.

Railway Motors.

The Tramway Motor Question. Alex. R. McCallum. Read before the Dick-Kerr Engng Soc. Considers the relative merits of series, shunt, and separately excited motors for ordinary tramway work. 2500 w. Elec Engr, Lond—Nov. 15, 1907. No. 88567 A.

Electric Braking of Series Motors for Continuous and Alternating Current in Electric Railways, and Particularly Mountain Lines (Die Verfahren der Elektrischen Bremsung von Seriemotoren für Gleichstrom und Wechselstrom bei Elektrischen Bahnen und besonders bei

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Elektrischen Bergbahnen). W. Kummer. 2500 w. Serial, 1st part. Schweiz Bau—Oct. 26, 1907. No. 88346 B.

Synchronous Motors.

A Graphic Calculator. Charles I. Young. Suggests a graphic chart for detetrmining quickly the power-factor improvement obtainable by the use of synchronous motors. 1700 w. Elec Jour—Nov., 1907. No. 88082.

Turbo-Generators.

See D. C. Turbo-Generators, under DYNAMOS AND MOTORS.

ELECTRO-CHEMISTRY.

Cell Arrangements.

The Best Multiple-Series Arrangement. Hugh S. Brown. Gives a method of determining the best multiple-series arrangement for any given number of cells. 1000 w. Elec Rev, N Y.—Nov. 23, 1907. No. 88514.

Corrosion.

The Relation between Polarization and the Corrosion of Iron Pipes by Stray Currents. Irving Langmuir. An account of experimental investigations and results. 4800 w. Stevens Ind—Oct., 1907. No. 88216 D.

Electro-Metallurgy.

See also same title, under MINING AND METALLURGY, IRON AND STEEL; and Lead Smelting and Zinc Smelting, under MINING AND METALLURGY, LEAD AND ZINC.

Electro-Plating.

The Leuchter Process of Reducing or Enlarging Models; and Its Connection with the Manufacture of Sterling-Silver and Plated Ware. Describes a process of great value in the manufacture of ornamental metal. Ills. 2000 w. Brass Wld—Nov., 1907. No. 88520.

A Beautiful and Durable Black Arsenic Deposit Without Use of Cyanide. J. Horton. Describes a method of producing a steel black deposit resembling gunmetal. 1200 w. Brass Wld—Nov., 1907. No. 88519.

Nitric Acid.

The Extraction of Nitric Acid from the Air by Means of the Electric Arc (Gewinnung von Salpetersäure aus Luft bei deren Behandlung mittels elektrischer Flamme). I. Moscicki. An illustrated description of the author's method and apparatus. 2700 w. Serial, 1st part. Elektrotech Zeitschr—Oct. 17, 1907. No. 88371 D.

Standard Cells.

Preliminary Specifications for Clark and Weston Standard Cells. F. A. Wolff and C. E. Waters. Based upon work done at the Bureau of Standards. 6500 w. Bul Bureau of Stand—Oct., 1907. No. 88251 N.

ELECTRO-PHYSICS.

Condensers.

Losses in Condensers with Fixed Dielectric and Their Damping in High-Frequency Circuits (Verluste in Kondensatoren mit Festem Dielektrikum und ihre Dämpfung in Hochfrequenzkreisen). Walther Hahnemann and Leonid Adelmann. A mathematical paper. Ills. 2300 w. Serial, 1st part. Elektrotech Zeitschr—Oct. 10, 1907. No. 88370 D.

Electric Arc.

Observations on the Electric Arc. W. L. Upson. Describes investigations made on arcs burning between metal electrodes, and between a metal and carbon electrode, in air, in hydrogen and in coal gas. Ills. 3500 w. Elect'n, Lond—Oct. 25, 1907. Serial, 1st part. No. 88093 A.

On the Electric Arc Between Metallic Electrodes. W. G. Cady and H. D. Arnold. Investigations of the change from the glow discharge to the arc between terminals of iron, platinum and copper and other metals. 9500 w. Am Jour of Sci—Nov., 1907. Serial, 1st part. No. 88029 D.

Magnetic Field.

A Standard Magnetic Field. R. Gans. Trans. from the *Phys. Zeit.* Mathematical investigations. 2000 w. Elect'n, Lond—Nov. 15, 1907. No. 88574 A.

Resistance.

The Variation of Manganin Resistances with Atmospheric Humidity. Edward B. Rose. A reply to the expressed views of Drs. Jaeger and Lindeck, that such variations are unimportant. 3800 w. Elect'n, Lond—Nov. 15, 1907. No. 88572 A.

GENERATING STATIONS.

Alternators.

A Phenomenon of Revolving Field Generators. F. Punga and W. Hess. Investigates the conditions under which an e. m. f. may be produced in the shaft of a revolving field machine. 1400 w. Elec Wld—Nov. 16, 1907. No. 88430.

The E. M. F. Generated in the Shafts of Alternators and a Suggested New Type of Low-Voltage Alternator. F. Punga and Dr. W. Hess. Calls attention to troubles experienced with bearings, offering an explanation. 1000 w. Elect'n, Lond—Oct. 25, 1907. No. 88095 A.

See also Compounding Alternators, under GENERATING STATIONS.

Central Stations.

Peoria Station of the Illinois Traction System. A new station equipped with turbines, water tubes and stokers is illustrated and described. 3300 w. Engr, U S A—Nov. 15, 1907. No. 88429 C.

Power Plant of the Pittsburg and Butler Street Railway Company. H. C. Reagan. Illustrated description of a turbine

plant and a single-phase system of transmission. 3000 w. Engr, U S A—Nov. 1, 1907. No. 88035 C.

A Steam Turbine Power Station. C. L. Vickery. Illustrated general description of the new Williamsburg Power Station of the Brooklyn Rapid Transit Co. 2500 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88122 N.

Steam-Driven Transmission Stations of the Societa Lombards, of Milan, Italy. Brief illustrated description of reserve stations. 2000 w. Elec Wld—Nov. 9, 1907. No. 88188.

Redondo Power Station of the Pacific Light & Power Company. Illustrated description of a large steam generating station in California. 1500 w. Elec Ry Rev—Nov. 2, 1907. No. 88084.

The Hochelaga Power Station of the Montreal Street Railway Company. Illustrated detailed description of a direct-current reciprocating-engine power plant. 2000 w. St Ry Jour—Nov. 9, 1907. No. 88200.

The Central Station of the International Naval Exposition at Bordeaux (La Station Centrale d'Electricité de l'Exposition Internationale Maritime de Bordeaux). Ch. Dantin. Illustrated description of the steam and electrical installations. 3000 w. Génie Civil—Oct. 19, 1907. No. 88329 D.

The Berlin Electric Installations at the Beginning of 1907 (Die Berliner Elektricitäts-Werke zu Beginn des Jahres 1907). K. Wilkens. The first part of the serial describes the steam plant in the generating station. Ills. 3200 w. Serial, 1st part. Elektrotech Zeitschr—Oct. 3, 1907. No. 88367 D.

The Electric Plants of the Rhine Valley Canal (Die Elektrizitätswerke am Rheintalischen Binnenkanal). Leopold Pasching. Illustrates and describes the central-station and sub-station installations for electric canal traction. 1500 w. Serial. 1st part. Elektrotech Zeitschr—Oct. 17, 1907. No. 88372 D.

See also Improvements, under GENERATING STATIONS.

Chili.

The Utilization of Water Power in Chili. A report by Prof. A. E. Salazar on the proposed electrification of a railway. 5000 w. Elect'n, Lond—Nov. 1, 1907. No. 88230 A.

Compounding Alternators.

A Method of Compounding Alternators. J. Rezelman and J. Perret. Abstract translation from *L'Eclairage Electrique*. Explains the principle employed and gives details of a three-phase turbo-generator. 1000 w. Elect'n, Lond—Nov. 1, 1907. No. 88229 A.

Hydro-Electric.

The Necaxa Power Works. The present article gives an illustrated description of the dams and channels of this plant in Mexico. 3000 w. Engr, Lond—Nov. 8, 1907. Serial, 1st part. No. 88483 A.

The Hydro-Electric Plant of the Black Hills Traction Company. Samuel H. Lea. The utilization of the Redwater River in South Dakota is illustrated and described. 1600 w. Eng Rec—Nov. 16, 1907. No. 88407.

The Works of the Vancouver Power Company (Ltd.). E. B. Hermon. Illustrated descriptive account of the hydro-electric power development. 7700 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88128 N.

The Hydro-Electric Development in the St. Mary's River at Sault Ste. Marie, Mich. Illustrated detailed description of the low-head hydro-electric generating station built in the rapids at the head of St. Mary's River. 3500 w. Eng Rec—Nov. 2, 1907. No. 88051.

The Rio de Janeiro Power Scheme. Illustrated detailed description of proposed plans for developing certain water power and transmitting the electric current over a distance of 51 miles to the city. 2200 w. Engr, Lond—Oct. 25, 1907. No. 88106 A.

Typical European Low-Head Hydro-Electric Power Plants. Charles H. Mitchell. Describes the main features of three typical hydro-electric plants operating under low heads, located in France, Italy and Switzerland. Ills. 3500 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88126 N.

The Caffaro-Brescia Transmission Plant (Die Kraftübertragungsanlage Caffaro-Brescia). The first instalment begins a description of the generating station at Caffaro. Ills. 2000 w. Serial, 1st part. Elektrotech Rundschau—Oct. 24, 1907. No. 88348 D.

See also Chili, under GENERATING STATIONS; and South America and Water Powers, under CIVIL ENGINEERING, WATERWAYS AND HARBORS.

Improvements.

Power Plant Improvements at El Paso. Outlines interesting work in carrying out necessary changes under hard conditions. Ills. 2500 w. St Ry Jour—Nov. 23, 1907. No. 88533.

Management.

Economic Considerations on the Management of Plant. W. H. Patchell. Pres. address before the Assn. of Engrs.-in-Charge. 5800 w. Elec Engr, Lond—Nov. 15, 1907. No. 88566 A.

Sub-stations.

The "Krummestrasse" Transformer

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Installation of the Berlin Elevated and Underground Railways (Das Umformerwerk "Krummestrasse" der Berliner elektrischen Hoch- und Untergrundbahn). Herr Idelberger. Illustrated detailed description. 1300 w. Serial. 1st part. Elektrotech Zeitschr—Oct. 31, 1907. No. 88375 D.

See same title, under STREET AND ELECTRIC RAILWAYS.

Switchboards.

Electrically-Operated Switchboards. B. P. Rowe. Considers their advantages, reliability, &c. Ills. 3000 w. Elec Jour—Nov., 1907. Serial, 1st part. No. 88083.

Tariffs.

A Discussion of Various Methods of Charging for Electric Energy. E. Richards. Brief explanation of the various methods, and their effects upon load factor. 2200 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88123 N.

Turbo-Generator Tests.

Tests of Large Turbo-Generators in the United States. Gives test results from two different types of turbine, each of which is practically the largest unit of its kind. Ills. 1500 w. Engr, Lond—Nov. 1, 1907. Serial, 1st part. No. 88238 A.

Wind Power.

Windmill Electricity Works in Denmark. A brief account of the utilization of the wind for power purposes. There are now more than 30 windmills driving electric generators. 1200 w. Elec Rev, Lond—Nov. 1, 1907. No. 88227 A.

LIGHTING.

Illumination.

Interior Electric Illumination. A. T. Beauregard. Discusses some of the fundamental principles governing the production and use of artificial light and its effects on the eye. 7000 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88124 N.

The Illumination of the Building of the Edison Electric Illuminating Company of Boston. Louis Bell, L. B. Marks and W. D'A. Ryan. Read before the Ill. Engng Soc. Illustrated detailed description. 8000 w. Elec Rev, N Y—Nov. 2, 1907. No. 88045.

Moore Light.

Discussion on "Light from Gaseous Conductors Within Glass Tubes—the Moore Light," at New York, April 26, 1907. 8000 w. Pro Am Inst of Elec Engrs —Oct., 1907. No. 88257 D.

Photometers.

The Sensitiveness of Photometers. Lancelot W. Wild. Describes experiments made to determine the relative sensitiveness of various types. 1200 w. Elect'n, Lond—Nov. 8, 1907. No. 88468 A.

Stages.

Electricity Applied to Stage Lighting. Jno. H. Kliegl. Illustrates and describes modern installations. 2500 w. Elec Rev, N Y—Nov. 16, 1907. No. 88270.

Theatres.

See Stages, under LIGHTING.

Train Lighting.

See same title, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

MEASUREMENT.

Central-Station Tests.

Convenient Tests for Central Station Operators. W. M. Hollis. Describes convenient methods of making measurements needed in central station practice with ordinary instruments. 1200 w. Elec Wld —Nov. 2, 1907. No. 88060.

Dielectric Strength.

See Insulation, under TRANSMISSION.

Inductance.

Self-Inductance of a Solenoid of Any Number of Layers. Louis Cohen. Formulæ are given for closer approximation than is possible with the Maxwell formula. 400 w. Elec Wld—Nov. 9, 1907. No. 88189.

On the Measurement of Mutual Inductance by the Aid of a Vibration Galvanometer. A. Campbell. Describes vibration galvanometer methods. 1500 w. Elect'n, Lond—Oct. 25, 1907. No. 88094 A.

Iron Losses.

Measurement of Iron Losses in Alternating-Current Operation (Messung der Eisenverluste im Wechselstrom-Betriebe). Johann Sahulka. A description of a new method used by the author. Ills. 2300 w. Elektrotech u Maschinenbau—Oct. 20, 1907. No. 88352 D.

Testing Generators.

Artificial Loading of Large High Voltage Generators. N. J. Wilson. Discusses the chief points to be taken into consideration in designing the required apparatus. 2000 w. Elec Jour—Nov., 1907. No. 88081.

Units.

A Comparison of the Various Methods of Determining the Ratio of the Electromagnetic to the Electrostatic Unit of Electricity. E. B. Rosa and N. E. Dorsey. 5800 w. Bul Bureau of Stand—Oct., 1907. No. 88250 N.

Wattmeters.

Effects of Short Circuits on the Drag Magnets of Watt-hour Meters. A. A. Radtke. Briefly describes experiments made, stating conclusions. 700 w. Elec Wld—Nov. 16, 1907. No. 88432.

Wattmeters for Overload Charges (Compteurs d'Energie Electrique pour Tarif à Dépassement). M. Aliamet. Dis-

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cusses the design of wattmeters for use in cases where a yearly contract is made for a certain amount of energy, with a special charge for amounts in excess of a stated maximum. Ills. 4000 w. Electricien—Oct. 5, 1907. No. 88319 D.

TRANSMISSION.

Aluminium.

Aluminium as a Substitute for Copper for Electrical Transmission Purposes. John B. Sparks. An investigation to determine the conditions under which the substitution of aluminium for copper tends to more economical results. 2000 w. Elec Rev, Lond—Nov. 15, 1907. Serial, 1st part. No. 88570 A.

Balancers.

Balancers Versus Three-Wire Dynamos. B. Frankenfield. Explains the operation of motor balancers, comparing them with three-wire dynamos, to the advantage of the former. 2000 w. Elect'n, Lond—Nov. 8, 1907. No. 88469 A.

Cable Constants.

Constants of Cables and Magnetic Conductors. Ernst J. Berg. Deductions and a discussion showing when approximate formulæ can properly be used. 2500 w. Pro Am Inst of Elec Engrs—Oct., 1907. No. 88256 D.

Cables.

See Insulation, under TRANSMISSION.

Direct Current.

The Modern Three-Wire Continuous-Current System. W. A. Toppin. On the popularity of this system in Great Britain, and the methods of testing. 1000 w. Elec Rev, Lond—Oct. 25, 1907. No. 88090 A.

Insulation.

The Dielectric Strength of Insulating Materials and the Grading of Cables. Alexander Russell. Read before the Inst. of Elec. Engrs. Discusses the laws of disruptive discharge; the methods of measuring the dielectric strengths; and the electric stresses on the insulating materials of a single-core cable. 3000 w. Elec Engr, Lond—Nov. 15, 1907. Serial. 1st part. No. 88568 A.

Insulators.

High Tension Insulators, from an Engineering and Commercial Standpoint. C. E. Delafield. Discusses the features to be desired in such insulators and the qualities of porcelain insulators. 3000 w. Cent Sta—Nov., 1907. No. 88185.

See also same title, under DISTRIBUTION.

Lightning Protection.

Defective Lightning Conductors. Discusses faults, their causes and the importance of a good earth, and a periodical test. 2800 w. Elec Rev, Lond—Nov. 8, 1907. No. 88467 A.

The Protection of Buildlings from Lightning. Alfred Hands. Lecture delivered at the Sch. of Military Engng. Describes cases of lightning damage, explaining the conclusions reached, and the methods advised for protection. 4200 w. Elec Engr, Lond—Nov. 15, 1907. Serial. 1st part. No. 88569 A.

A Comparison of Various Types of Lightning Arresters with Reference to Their Efficiency (Vergleich verschiedener Starkstrom-Blitzableiter in Bezug auf ihre Wirksamkeit). F. Neesen. A record of extensive tests of their practical efficiency. Ills. 4500 w. Elektrotech Zeitschr—Oct. 3, 1907. No. 88369 D.

Losses.

Units Used in Distribution. W. A. Tappin. Deals with losses in direct-current systems. 2500 w. Elec Engr, Lond—Nov. 1, 1907. No. 88226 A.

An Analysis of the Distribution Losses in a Large Central Station System. L. L. Elden. Considers a typical system, giving much information of value. 2500 w. Pro Am Inst of Elec Engrs—Nov., 1907. No. 88599 D.

Niagara.

Niagara Power Transmission. T. H. Hogg. A brief description of the line between Niagara Falls, Ont., and Syracuse, N. Y., and of some of the difficulties of its construction. Ills. 3500 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88121 N.

Rhone-Paris.

The Project for the Transmission of Power from the Rhone to Paris (Le Projet d'Adduction à Paris des Forces Motrices du Rhone). G. de Lamarcodie. Reviews other long-distance transmissions and outlines the main features of the 450-kilometre Rhone-Paris project. Ills. 5000 w. Rev Gén d Sci—Oct. 15, 1907. No. 88316 D.

Rotary Converters.

The Starting of Rotary Converters. George I. Rhodes. Describes several methods stating the relative advantages of each. 3500 w. Elec Age—Nov., 1907. No. 88548.

Synchronous Converters.

Discussion on "Motor-Generators *vs.* Synchronous Converters, with Special Reference to Operation on Long-Distance Transmission Lines," at New York, March 22, 1907. 15500 w. Pro Am Inst of Elec Engrs—Oct., 1907. No. 88258 D.

Transformers.

See Sub-stations, under GENERATING STATIONS.

Voltage Rise.

Conditions Producing a Higher Voltage Than Normal at the Receiving End of a Line. Charles Jenkins Spencer. Describes the conditions. 1200 w. Elec Age—Nov., 1907. No. 88547.

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MISCELLANY.

Agriculture.

Electric Power and Light Plants in Agriculture with Reference to the New Plant of the Libnitz Estate at Rügen (Elektrische Kraft- und Lichtanlagen in der Landwirtschaft mit Berücksichtigung der neuen Anlage auf Rittergut Libnitz auf Rügen). E. W. Lehmann-Richter. Describes the generation of power and its applications. Ills. 3500 w. Elektrotech Zeitschr—Oct. 24, 1907. No. 88373 D.

INDUSTRIAL ECONOMY

Apprenticeship.

The Rising Industrial Problem; the New Apprenticeship. George Frederic Stratton. Gives interesting facts concerning shop conditions and the attitude of trade unionism towards apprenticeship systems and trade schools. 6000 w. Engineering Magazine—Dec., 1907. No. 88622 B.

Correspondence Filing.

The Filing of Correspondence in a Manufacturing Business. Sterling H. Bunnell. Describes a system suited to the needs of the production department. 1700 w. Engineering Magazine—Dec, 1907. No. 88628 B.

Cost Estimation.

The Estimation of Costs in General Engineering Work. F. T. Clapham. Discusses the difficulties and gives an example of a system. 4000 w. Mech Engr—Nov. 9, 1907. No. 88465 A.

Education.

Engineering Laboratory Instruction. W. W. F. Pullen. Read at meeting of the Assn. of Teachers in Tech. Inst. Considers laboratory instruction generally, and also in the technological laboratory. 3500 w. Mech Engr—Nov. 16, 1907. No. 88577 A.

Mining Engineering Education in the United States. Victor C. Alderson. Extract from paper read at Joplin meeting of Am. Min. Cong. Considers causes resulting in a low general standard for mining education and recent improvement in teaching methods. 1500 w. Min Rept—Nov. 14, 1907. Serial, 1st part. No. 88414.

Industrial Betterment.

The Industrial Betterment Movement. H. F. J. Porter. How it has improved conditions of employees, and increased prosperity. 4000 w. Am Mach—Vol. 30. No. 45. No. 88176.

Patent Law.

Patents and Designs.—The New Act. J. A. Law. Treats of a new act, in England, embodying alterations in the law relating to patents and designs, of great importance to inventors, manufacturers and others. 5000 w. Jour Soc of Arts—Nov. 8, 1907. No. 88494 A.

Safety Devices.

A Bavarian Museum of Industrial Safety Devices. Dr. Alfred Gradenwitz. Illustrates and describes exhibits at this German museum for safeguarding dangerous occupations. 3500 w. Engineering Magazine—Dec., 1907. No. 88625 B.

Secrecy.

Secrecy in the Arts. James Douglas. Urges the banishment of secrecy of methods and engineering data and outlines a policy of freedom. 6000 w. Bul Am Inst of Min Engrs—Nov, 1907. No. 88639 C.

Shop Management.

See Management, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Wages.

Wages and the Cost of Living in the United States and Canada. Dudley W. Walton. Gives comparative tables and general information. 2000 w. Elec Rev, Lond—Nov. 15, 1907. No. 88571 A.

MARINE AND NAVAL ENGINEERING

Ammunition Holds.

Ventilation and Refrigeration of Ammunition Holds. Adrien Bachet. Abstract translation of paper read before the Bordeaux Int. Cong. of Nav. Archts. Methods of ventilating with cooled air are considered. 2000 w. Marine Rev—Nov. 7, 1907. No. 88178.

Buoy.

The Bredsdorff Stranding Buoy. Illustrated description of a novel buoy for facilitating communication between a stranded ship and the shore. 700 w. Sci Am—Nov. 16, 1907. No. 88242.

Davits.

Appliances for Manipulating Lifeboats on Sea-Going Vessels. Axel Welin. States the principal requirements of an ideal system of davits and gives an illustrated description of the Welin Quadrant Davit.

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1500 w. Trans Am Soc of Nav Archts and Marine Engrs, No. 10—Vol. 15, 1907. No. 88446 N.

Destroyers.

The New Ocean-Going Destroyers. Illustrated description of H. M. torpedo-boat destroyer "Corsack," with report of trials. 2000 w. Engng—Nov. 8, 1907. No. 88478 A.

Development.

Address of Sir William Matthews, President of the Institution of Civil Engineers. With editorial. 5000 w. Engng—Nov. 8, 1907. Serial. 1st part. No. 88480 A.

Dredges.

See same title, under CIVIL ENGINEERING, WATERWAYS AND HARBORS.

Fire Boats.

Fire Boat Protection. Edward F. Croker. The design and construction considered from the viewpoint of the fireman and the engineer. Ills. 3300 w. Sci Am Sup—Nov. 23, 1907. No. 88501.

Internal-Combustion Engines.

Ship Propulsion by Internal Combustion Engines. A. Vennell Coster. An illustrated discussion of the advantages, objections, applications and success attained. 6000 w. Cassier's Mag—Nov., 1907. Special No. No. 88286 D.

Magnetism.

The Magnetic Properties of Ships (Schiffsmagnetismus). Dr. H. Meldan. A review of the historical and modern methods of compensation and of the sources and kinds of ship magnetism. Ills. 4000 w. Schiffbau—Oct. 9, 1907. No. 88341 D.

Mauretania.

The Trials of the "Mauretania." Editorial on the official trials. 2000 w. Engng—Nov. 8, 1907. No. 88479 A.

The Cunard Turbine-Driven Quadruple-screw Atlantic Liner, "Mauretania." Fully illustrated detailed description of this vessel, its construction, equipment and crew, with an account of all matters relating to it and of the works where it was built. 48000 w. Engng—Nov. 8, 1907. No. 88477 A.

Mine Laying.

A New Mine Laying Steamer. Illustrated description of the Capt. A. M. Wetherill, a steamer for harbor service in connection with planting submarine mines. 1500 w. Int Marine Engng—Dec, 1907. No. 88517 C.

Monitors.

Some Early History Regarding the Double-Turreted Monitors Miantonomah and Class. William T. Powell. Concerning vessels built 30 years ago and still in service. 1500 w. Plates. Trans Am Soc of Nav Archts and Marine Engrs, No. 14—Vol. 15, 1907. No. 88450 N.

Motor Boats.

Motor Boats for Naval Service. L. S. Adams. Discusses the principal objections to their use and the advantages. Ills. 5000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 5—Vol. 15, 1907. No. 88441 N.

High Speed Motor Boats for Pleasure Use. Henry R. Sutphen. Illustrations, with brief descriptions, of boats of moderate power, with remarks on high-speed boats. 1200 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 6—Vol. 15, 1907. No. 88442 N.

Some Observations on Motor-Propelled Vessels and Notes on the Bermuda Race. William B. Stearns. Considers details of design and arrangement, and some engine and fuel problems. 4000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 7—Vol. 15, 1907. No. 88443 N.

Oil Fuel.

Oil Fuel on Shipboard. Graydon Hume. Read before the Inst. of Marine Engrs. Discusses its relative value as a heat producer, and the economy to be expected from its application. 5000 w. Naut Gaz—Nov. 7, 1907. No. 88179.

The Importance of Liquid Fuels in the Construction, Operation and Profitableness of a Transatlantic Liner (Die Bedeutung der flüssigen Feuerung für Konstruktion, Betrieb und Rentabilität eines Transatlantischen Schnell d a m p f e r s). Ernst Foerster. Ills. 6500 w. Serial. 1st part. Schiffbau—Oct. 9, 1907. No. 88,340 D.

Refrigeration.

See same title, under MECHANICAL ENGINEERING, HEATING AND COOLING.

Repairs.

Two Instances of Unusual Repairs to Vessels. S. W. B. Ferguson, Jr. An account of repairs to the bottom of the collier Nero after grounding; and to Lightship No. 68, which was seriously corroded and eaten away by electrolysis. Ills. 2000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 12—Vol. 15, 1907. No. 88448 N.

Resistance.

An Experimental Investigation of Stream Lines Around Ships' Models. D. W. Taylor. Diagrams and description of methods of investigation at the U. S. Ex. Model Basin. 1500 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 1—Vol. 15, 1907. No. 88437 N.

Some Experiments on the Effect of Longitudinal Distribution of Displacement Upon Resistance. Prof. Herbert C. Sadler. Gives results of a partial investigation made at the University of Michigan. Plates. 1500 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 2—Vol. 15, 1907. No. 88438 N.

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Revenue Cutters.

Two New Revenue Cutters for Special Purposes. C. A. McAllister. Brief descriptions of Nos. 16 and 17, with drawings and explanation of the special work for which they were designed. Ills. 4500 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 8—Vol. 15, 1907. No. 88444 N.

Sailing Ships.

Wooden Sailing Ships. B. B. Crowninshield. Reviews the development of this type of vessel, with particular reference to those built before the Civil War. Ills. 5000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 13—Vol. 15, 1907. No. 88449 N.

Shipbuildling.

New Works on the Clyde. Illustrated detailed description of the new works of Yarrow & Co. Ltd. and their equipment. 8500 w. Engr, Lond—Nov. 15, 1907. No. 88586 A.

Building a Transatlantic Liner. An illustrated account of the building of the "Kronprinzessin Cecilie." 2000 w. Sci Am Sup—Nov. 30, 1907. No. 88595.

Steamboats.

Robert Fulton and the Sidewheel Steamboat. J. H. Morrison. Reviews information available relating to paddle-wheels and their use, and Fulton's application of them to the "Clermont." Ills. 4000 w. Sci Am Sup—Nov. 2, 1907. No. 88019.

Steam Engines.

The Marine Type of Beam Engines. R. C. Monteagle. Gives a general idea of the design of this type of engine, illustrating by drawings. 4000 w. Tech Qr—Sept, 1907. No. 88075 E.

Steamships.

The Hamburg - American Steamer Kronprinzessin Cecilie. F. C. Guenther. Illustrated detailed description. 2500 w. Int Marine Engng—Dec, 1907. No. 88516 C.

Steamship Trials.

Test of the S. S. Governor Cobb. Prof. W. S. Leland and H. A. Everett. A report of a test-run by the Mass. Inst. of Tech. 900 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 9—Vol. 15, 1907. No. 88445 N.

See also Mauretania, and Destroyer, under MARINE AND NAVAL ENGINEERING.

Steam Turbines.

Ahead and Astern Turbines and Superheating in Turbine Steamers (Marschturbinen, Rückwärtsturbinen und Ueberhitzung bei Turbinenschiffen). Felix Langen. The first part of the serial deals with the steam consumption of turbine steamers. 2000 w. Serial. 1st part. Schiffbau—Oct. 9, 1907. No. 88343 D.

Submarines.

Submarines of Battleship Speed. Mason S. Chace. Discusses possible features of designs; the powers needed to obtain high speeds, and various improvements desirable to increase the usefulness of these vessels. Plates. 7000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 4—Vol. 15, 1907. No. 88440 N.

Warships.

Further Tactical Considerations Involved in Warship Design. A. P. Niblack. An outline of the problem of handling a ship in action. 2000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 3—Vol. 15, 1907. No. 88439 N.

MECHANICAL ENGINEERING

AUTOMOBILES.

Acetylene Lighting.

Acetylene Light for Automobiles. Eugene Bournonville. Brief description of acetylene generators appropriate for automobile use. 1200 w. Automobile—Nov. 7, 1907. No. 88141.

Adams.

The 10-H. P. Adams Car. Illustrates and describes a 4-seated, side-entrance model. 900 w. Auto Jour—Oct. 26, 1907. No. 88085 A.

Albion.

The 24-H. P. Albion Car. Illustrated detailed description of this British car. 2000 w. Autocar—Oct. 26, 1907. Serial. 1st part. No. 88087 A.

American Automobiles.

Tabular Story of the American Automobile. Gives tables on the basis of cost, with introductory remarks. 3500 w. Automobile—Nov. 28, 1907. No. 88608.

Argyll.

The New 40-H. P. Argyll. Illustrated detailed description. 2500 w. Autocar—Nov. 9, 1907. No. 88456 A.

Austin.

The 1908 Austin Cars. Illustrated description of a chassis having a 6-cylinder engine. 600 w. Auto Jour—Nov. 16, 1907. Serial. 1st part. No. 88564 A.

Beeston-Humber.

The 1908 Beeston-Humber Cars. Illustrates and describes the special features. 600 w. Auto Jour. Nov. 9, 1907. Serial. 1st part. No. 88454 A.

B. S. A.

The B. S. A. Petrol Cars. Special fea-

tures, with illustrations, of these models. 700 w. Auto Jour. Nov. 9, 1907. Serial. 1st part. No. 88457 A.

Cadillac.

The 20-H. P. Cadillac Car. Illustrated description. 600 w. Auto Jour—Nov. 9, 1907. Serial. 1st part. No. 88460 A.

Commercial Vehicles.

Commercial Vehicles of the Garden Show. W. F. Bradley. Illustrations, with descriptive notes. 1000 w. Automobile—Nov. 7, 1907. No. 88140.

See also Motor Cabs, under AUTOMOBILES.

Coventry-Humber.

The 1908 Coventry-Humber Cars. The new model is a 10 h.p. vehicle. The special features are illustrated and described. 500 w. Auto Jour—Nov. 9, 1907. Serial. 1st part. No. 88455 A.

Cylinders.

Battle of the Cylinders: Six v. Four. F. B. Stearns. A comparison of the advantages and disadvantages. 1500 w. Automobile—Oct. 31, 1907. No. 88006.

Daimler.

The 1908 Daimler Cars. Illustrated description of new features. Line-axle models, and the adoption of worm gearing on chain-driven cars. 800 w. Auto Jour—Nov. 9, 1907. Serial. 1st part. No. 88452 A.

Darracq.

The New Darracq Models for 1908. Illustrated description of several changes made in the vehicles of this company. 1800 w. Auto Jour—Nov. 2, 1907. No. 88223 A.

Exhibition.

Motor Car Exhibition at Olympia. Illustrated review of the exhibits. 2800 w. Engr, Lond—Nov. 15, 1907. Serial. 1st part. No. 88588 A.

The Motor-Car Exhibition at Olympia. An illustrated review of the exhibits. 3500 w. Engng—Nov. 15, 1907. Serial. 1st part. No. 88581 A.

Fore-Carriage.

The Pullcar—A Petrol-Driven Fore-Carriage. Illustrated description of a self-propelled fore-carriage to which any type of carriage may be attached. 2000 w. Auto Jour—Nov. 2, 1907. No. 88222 A.

Friction Transmission.

A Motor Cab with Friction-Disc Transmission (Fiacre Automobile à Transmission par Phateaux de Friction). A. Le Vergnier. Illustrated description of a car in use in Berlin. 1400 w. Génie Civil—Oct. 19, 1907. No. 88328 D.

Gasoline.

The Gasoline Automobile. Forrest R. Jones. Illustrates and describes features of modern cars. 5500 w. Cassier's Mag—Nov., 1907. Special No. No. 88287 D.

Hillman-Coatalen.

The Hillman-Coatalen Petrol Cars. Illustrated description of the leading characteristics. 600 w. Auto Jour—Nov. 9, 1907. Serial. 1st part. No. 88459 A.

Ignition.

The New Nelmelior Magneto. Illustrated description. 1500 w. Autocar—Oct. 26, 1907. No. 88086 A.

The Lodge Igniter. Illustrates and describes an invention of Sir Oliver J. Lodge, shown at the Olympia exhibition. 1200 w. Autocar—Nov. 9, 1907. No. 88,462 A.

Concerning the Progress of Ignition. Charles B. Hayward. An illustrated review of advances made in the quality of materials and application of principles involved. 3300 w. Automobile—Nov. 21, 1907. No. 88510.

Motor Cabs.

Taximeter Motor Cabs in America. Harry W. Perry. Illustrated descriptions of the Delahaye and the Darracq vehicles. 1000 w. Sci Am—Nov. 9, 1907. No. 88,161.

Motors.

The Rollason Six-Stroke Petrol Engine. Gives details of construction and tests of a new type of petrol engine. 2200 w. Autocar—Nov. 9, 1907. No. 88463 A.

Engines of the 1908 Models. Charles B. Hayward. Brief illustrated descriptions of types shown at the Madison Sq. Garden exhibition. 3000 w. Automobile—Nov. 7, 1907. No. 88139.

Perfection.

The Perfect Automobile: A Layman's Idea. G. H. Godley. Outline design and description of the writer's idea. 2000 w. Automobile—Nov. 21, 1907. No. 88511.

Sheffield-Simplex.

The Sheffield-Simplex Petrol Cars. A new name and new design for the "Brotherhood" cars. Illustrated description. 600 w. Auto Jour—Nov. 9, 1907. Serial. 1st part. No. 88453 A.

Shock Absorbers.

Types of Shock Absorbers for Automobiles. Howard Greene. Illustrated description of types. 2800 w. Sci Am—Nov. 9, 1907. No. 88160.

Siddleley.

45-Horse-Power Siddeley Motor-Car. Illustrated detailed description of this car for the Queen, which will be exhibited at Olympia. 1600 w. Engng—Nov. 1, 1907. No. 88235 A.

Testing.

Tests of Automobiles (Messungen an Motorwagen). A. Heller. An illustrated description of electrical methods of rating motor cars. 3300 w. Zeitschr d Ver Deutscher Ing—Oct. 5, 1907. No. 88,361 D.

Thornycroft.

The New 30-H. P. and 45-H. P. Thornycroft Cars. Illustrated descriptions. 700 w. Auto Jour—Nov. 9, 1907. Serial. 1st part. No. 88458 A.

Tires.

Quick-Change Tires to the Fore. W. F. Bradley. Illustrates and describes types of quick-change rims, and of dismountable rims. 2500 w. Automobile—Nov. 28, 1907. No. 88609.

Turner-Miesse.

The 30-H. P. Turner-Miesse Steam Car. Illustrated detailed description. 1000 w. Autocar—Nov. 9, 1907. No. 88461 A.

COMBUSTION MOTORS.

By-Product Producers.

By-Product Recovery Gas Producer Plants. H. A. Humphrey. Treats of the recovery of sulphate of ammonia from the wastes of the gas producer, showing the success attained by Dr. Ludwig Mond. Ills. 3000 w. Cassier's Mag—Nov, 1907. Special No. No. 88282 D.

Fly-wheels.

A Fan Fly-wheel for Gasolene Engines. E. J. Bartlett. The design and construction of a combination of fan and fly-wheel is illustrated and described. 1000 w. Am Mach—Vol. 30. No. 47. No. 88498.

Gas Engines.

The Jacobson Automatic Gas Engine. Illustrated description of an engine designed for close regulation when working on producer gas. 1100 w. Engr, U S A—Nov. 15, 1907. No. 88427 C.

Recent Applications of Gas Power. J. R. Bibbins. Reviews interesting features developed in the application of the internal-combustion engine. 2200 w. Cassier's Mag—Nov, 1907. Special No. No. 88289 D.

The Development of the Large Gas Engine in America. E. T. Adams. An illustrated review. 3000 w. Cassier's Mag—Nov, 1907. Special No. No. 88281 D.

The Gas-Power Situation in Germany. F. E. Junge. A discussion of recent progress in the design and construction of large gas engines. Ills. 4000 w. Cassier's Mag—Nov, 1907. Special No. No. 88285 D.

Large Gas and Steam Engines. W. H. Booth. The present article considers gas engines. Ills. 4500 w. Cassier's Mag—Nov, 1907. Serial. 1st part. Special No. No. 88290 D.

Chief Points of Difference Between the Gas Engine and the Steam Engine. William H. Booth. Shows that they differ fundamentally in the essentials of practice. 2500 w. Power—Nov, 1907. No. 88011 C.

Gas-Engine Peculiarities as Compared with Those of the Steam-Engine. Horace Allen. Shows that faults in the design or management of gas engines, or gas producers, have caused condemnation. 2800 w. Elec Engr, Lond—Nov. 15, 1907. No. 88565 A.

On the Indicated Power and Mechanical Efficiency of the Gas-Engine. Prof. Bertram Hopkinson. Gives an account of tests made to determine whether the indicator power of the gas engine does vary, and is so difficult to obtain as reported. Gives also results of tests for mechanical efficiency. Ills. 8800 w. Inst of Mech Engrs—Oct. 18, 1907. No. 88088 N.

Control of Internal Combustion in Gas Engines. Charles Edward Lucke. Examines the conditions under which constancy of effort may, or may not, be obtained with constancy of setting of the governor and valve gear. 3500 w. Pro Am Soc of Mech Engrs—Mid-Nov, 1907. No. 88601 C.

The Influence of Mixture Ratios on the Utilization of Heat in the Gas Engine (Der Einfluss des Mischungsverhältnisses auf die Wärmeausnutzung in der Gasmaschine). Gustav Mees. Records in numerous curves the results of extensive tests. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—Oct. 5, 1907. No. 88,-362 D.

The Dependence of the Utilization of Heat in the Gas Engine on the Mixture Ratio (Die Abhängigkeit der Wärmeausnutzung der Gasmaschine vom Mischungsverhältnis). K. Kutzbach. A discussion and amplification of a paper by Gustav Mees. Ills. 8300 w. Zeitschr d Ver Deutscher Ing—Oct. 19, 1907. No. 88,-364 D.

See also Gas Plant Testing, Gas vs. Steam, and Historical Review, under COMBUSTION MOTORS; Internal-Combustion Engines, under MARINE AND NAVAL ENGINEERING; Blast-Furnace Gas and Blowing Engines, under MINING AND METALLURGY, IRON AND STEEL; and Gas Power, under MINING AND METALLURGY, MINING.

Gas Plant Testing.

Duty Test on Gas Power Plant. G. J. Alden and J. R. Bibbins. A report of the duty test of the gas power plant of the Norton Co., Worcester, Mass. 6000 w. Pro Am Soc of Mech Engrs—Mid-Nov, 1907. No. 88603 C.

Gas Producers.

Atkinson Automatic Suction Gas Producer. Illustrated detailed description. 1600 w. Engr, U S A—Nov. 15, 1907. No. 88428 C.

The Utilization of Low-Grade Fuels in the Gas Producer. C. T. Wilkinson.

We supply copies of these articles. See page 715.

Gives accurate data of tests upon four such fuels, discussing the results. 1000 w. Cassier's Mag—Nov., 1907. Special No. No. 88284 D.

Power Gas from Bituminous Coal. Elbert A. Harvey. An illustrated review of the progress and features of the bituminous producer. 3000 w. Cassier's Mag—Nov., 1907. Special No. No. 88292 D.

The Suction Gas Producer. F. J. Rowan. An illustrated explanation of the principles and construction, giving results of working. 6000 w. Cassier's Mag—Nov., 1907. Special No. No. 88291 D.

See also By-Product Producers, Gas Plant Testing, Gas vs. Steam, and Producer Gas, under COMBUSTION MOTORS.

Gas vs. Steam.

Test of a Producer Gas Plant. J. H. Alexander. Reports comparative tests of steam and gas plants as to efficiencies, first cost and cost of operation. 1800 w. Engr, U S A—Nov. 1, 1907. No. 88038 C.

Producer Gas for Power. S. L. Fear. Compares the efficiency of the suction gas producer plant and the steam plant, giving a short description of the former. Ills. 2500 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88130 N.

Heat Losses.

A Study of the Heat-Losses in a Gasoline Engine. Arthur J. Ward. A report of tests made. 2000 w. Stevens Ind—Oct, 1907. No. 88217 D.

Historical Review.

Historical Review of the Development of the Internal-Combustion Engine. Henry Harrison Suplee. Photographs of inventors and illustrations of engines. 7000 w. Cassier's Mag—Nov, 1907. Special No. No. 88279 D.

Oil Engines.

See Internal-Combustion Engines, under MARINE AND NAVAL ENGINEERING.

Producer Gas.

Producer-Gas Composition and Its Influence on the Performance of Suction-Producer Plants. Godfrey M. S. Tait. Considers the most desirable composition for the operation of gas engines. Ills. 2200 w. Cassier's Mag—Nov, 1907. Special No. No. 88288 D.

The Present Status of the Producer-Gas Power Plant in the United States. Robert Heywood Fernald. An illustrated review of development and report of tests made by the U. S. Geol. Surv., giving views of manufacturers, owners, and operators, and much information. General discussion. 22500 w. Jour W Soc of Engrs—Oct, 1907. No. 88522 D.

See also Gas Producers, under COMBUSTION MOTORS; and Producer Gas, under POWER AND TRANSMISSION.

HEATING AND COOLING.

Hot-Air Heating.

Gravity Air Heating in a Library Building. Illustrated description of an interesting furnace installation in a Furman University building, at Greenville, S. C. 2000 w. Met Work—Nov. 9, 1907. No. 88144.

Indirect Heating.

Indirect Heating in a Detroit Factory. Illustrated detailed description of a fan system with arrangements for internal circulation. 2000 w. Met Work—Nov. 2, 1907. No. 88032.

Refrigeration.

The Absorption Ice Plant. Heywood Cochran. Read at meeting at the Jamestown Exposition. Reviews the history of the absorption system. 2500 w. Ice & Refrig—Nov, 1907. No. 88213 C.

Laying Up an Ice Plant. William S. Luckenbach. Suggestions applying principally to the absorption system. Ills. 3000 w. Engr, U S A—Nov. 1, 1907. No. 88039 C.

The Influence of Refrigeration on the World's Work. John E. Starr. Read at meeting at the Jamestown Exposition. Reviews what has been achieved and gives predictions for the future. 3800 w. Ice & Refrig—Nov, 1907. No. 88211 C.

The Transportation of Refrigerated Meat to Panama. Roland Allwork. An illustrated description of steamship refrigeration. 4000 w. Trans Am Soc of Nav Archts & Marine Engrs, No. 11—Vol. 15, 1907. No. 88447 N.

Pipe Line Refrigeration. R. H. Tait. Read at meeting at the Jamestown Exposition. On the possibility of enlarging the revenue producing power of plants. 2000 w. Ice & Refrig—Nov, 1907. No. 88214 C.

Compression Ice Plants Using Ammonia as a Refrigerant. Thomas A. Shipley. Read at meeting at the Jamestown Exposition. Considers general problems of ice plants, the quantity, quality and economy. 4000 w. Ice & Refrig—Nov, 1907. No. 88212 C.

The Mechanical Equipment of the North American Cold-Storage Building, Chicago. The mechanical plant for a modern, fireproof, cold-storage warehouse is illustrated and described in detail. 3000 w. Eng Rec—Nov. 16, 1907. No. 88408.

See also same title, under RAILWAY ENGINEERING, TRAFFIC.

Regulating Valves.

Steam Flow Through Regulating Valves in Low-Pressure Steam Heating (Ueber den Dampfdurchgang durch Regulierventile in Wiederdruckdampfheizungen). Gives in curves and tables the re-

sults of very extensive tests. Ills. 4000 w. Serial. 1st part. Gesundheits-Ing—Oct. 12, 1907. No. 88359 D.

Steam Heating.

See Regulating Valves, under HEATING AND COOLING.

Window Leakage.

Window Leakage and Its Effect on the Amount of Radiation. Burt S. Harrison. A report of a test made, with charts, and an explanation of their use. 2200 w. Heat & Vent Mag—Nov, 1907. No. 88521.

HYDRAULICS.

Centrifugal Pumps.

Centrifugal Pumps. E. F. Doty. Gives some reasons why modern designs are more efficient. Ills. 2000 w. Engr, U S A—Nov. 1, 1907. No. 88036 C.

Centrifugal Pumps. E. F. Doty. Discusses causes of lost energy and lift. 1200 w. Engr, U S A—Nov. 15, 1907. No. 88426 C.

Orifices.

See same title, under CIVIL ENGINEERING, WATER SUPPLY.

Pumping Machinery.

The Pumping Machinery Employed in Mining. Jas. H. Hart. Reviews briefly the types of pumps and considers the available improvements. 1300 w. Min Wld—Nov. 2, 1907. No. 88070.

Pumping Plants.

The Chicago Avenue Pumping Station. Henry A. Allen. Illustrates and describes a fine station, with capacity of 75,000,000 gallons in 24 hours. 2500 w. Engr, U S A—Nov. 15, 1907. No. 88425 C.

The Use of Small Pumping Plants in Connection with Sewerage Systems. Irving T. Farnham. Illustrated description of the Newton (Mass.), pumping plant. General discussion. 10000 w. Jour Assn of Engng Socs—Oct, 1907. No. 88491 C.

Water Meters.

See same title, under CIVIL ENGINEERING, WATER SUPPLY.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

Ball Bearings in a Marble Plant. Charles Prescott Fuller. An illustrated account of how the use of ball-bearings scored a success in marble machinery. 2200 w. Am Mach—Vol. 30. No. 45. No. 88167.

Progress with Ball and Roller Bearings. S. S. Eveland and Henry Hess. Reviews the progress made in substituting rolling for sliding friction. 3500 w. Am Mach—Vol. 30. No. 45. No. 88172.

Jigs.

Locating and Boring Holes in Drill Jigs. C. L. Goodrich. Various methods are illustrated and described. 3500 w. Am Mach—Vol. 30. No. 47. Serial. 1st part. No. 88495.

See also same title, under MACHINE WORKS AND FOUNDRIES.

Roller Bearings.

See Ball Bearings, under MACHINE ELEMENTS AND DESIGN.

Shears.

The Design of Heavy Shears (Bau Schwerer Scheren). E. Kühne. An illustrated mathematical discussion. 3200 w. Serial. 1st part. Zeitschr f Werkzeug—Oct. 5, 1907. No. 88349 D.

Thrust Bearing.

Largest Anti-Friction Thrust Bearing Ever Made. Describes in detail the design, construction and test of a roller thrust bearing carrying a load of 150,000 pounds. Ills. 2500 w. Am Mach—Vol. 30. No. 45. No. 88163.

MACHINE WORKS AND FOUNDRIES.

Bearings.

Hot Bearings. E. Kistinger. Considers their causes and means of avoiding them. Ills. 2000 w. Mach, N Y—Nov, 1907. No. 88065 C.

Boiler Making.

The Making of the Marine Boiler (Die Herstellung der Schiffskessel). Walter Mentz. An illustrated description of the various machines and processes used. 1200 w. Serial. 1st part. Schiffbau—Oct. 9, 1907. No. 88342 D.

Brazing.

The Brazing and Reinforced Brazing of Metals. Illustrates and describes examples with and without reinforcement. 2500 w. Am Mach—Vol. 30. No. 45. No. 88165.

Buildings.

See Factories and Reinforced Concrete, under CIVIL ENGINEERING, CONSTRUCTION.

Case-Hardening.

A Process and Apparatus for the Cementation of Iron and Steel (Procédé et Appareil pour la Cémentation des Objets en Fer et en Acier). Outlines a recently developed process for case-hardening by means of contact with a hydro-carbon gas. Ills. 3400 w. Serial. 2 parts. La Métallurgie—Oct. 9 and 16, 1907. No. 88323, each D.

Castings.

Sash Weights Cast in Chills. Illustrated description of novel equipment for their rapid production. 1200 w. Foundry—Nov, 1907. No. 88024.

See also Foundry Furnaces, under MACHINE WORKS AND FOUNDRIES.

Cement Plant.

A Plant for Making White Portland Cement and Using Producer Gas for Fuel. Detailed description. 1300 w. Eng News—Nov. 7, 1907. No. 88115.

Cupolas.

Foundry Cupola and Iron Mixtures. W. J. Keep. Describes a special form of cupola and its operation, and discusses the composition of iron mixtures. 7700 w. Pro Am Soc of Mech Engrs—Nov, 1907. No. 88078.

Cutting Tools.

Standard Shapes for Cutting Tools. William H. Taylor. Giving detailed instruction for forging and grinding tools according to F. W. Taylor's standard shapes and sizes. Ills. 4000 w. Am Mach—Vol. 30. No. 45. Serial. 1st part. No. 88164.

See also High-Speed Steel, under MATERIALS OF CONSTRUCTION.

Floor Plates.

Machine Operations Over Iron Floor Plates. John Riddell. An illustrated explanation of how portable machine tools are used on floor plates and description of a new rail floor construction. 1700 w. Am Mach—Vol. 30. No. 48. No. 88613.

Forging.

See Ingot Casting, under MINING AND METALLURGY, IRON AND STEEL.

Foundry Design.

Foundry Design and Equipment. A. R. Bellamy. Abstract paper read before the Manchester (Eng.) Assn. of Engrs. Discusses whether a foundry can be successful as a part of a manufacturing business; what determines the decision to build a foundry; and the points to be considered. Ills. 5500 w. Mech Engr—Nov. 16, 1907. No. 88575 A.

Foundry Furnaces.

Converter vs. Small Open Hearth. W. M. Carr. Discusses the advantages and disadvantages of these two processes for the manufacture of steel castings. 1800 w. Foundry—Nov, 1907. Serial. 1st part. No. 88026.

See also Cupolas, under MACHINE WORKS AND FOUNDRIES.

Foundry Materials.

Specifications for Iron and Fuel, and Method of Testing Foundry Output. R. Moldenke. Discusses the value of specifications and the standards prevailing, commending the set recently adopted by the Am. Found. Assn., and the Am. Soc. for Test. Mat. 2500 w. Pro Am Soc of Mech Engrs—Nov, 1007. No. 88079.

Foundry Practice.

Foundry Notes. Suggestions for the making of successful castings. 1200 w. Prac Engr—Nov. 1, 1907. No. 88225 A.

Gates and Rises or Sink-Heads. P. R. Ramp. Brief explanation of methods in vogue. Ills. 700 w. Foundry—Nov, 1907. No. 88022.

Production of Malleable Fittings. Illustrates and describes methods of manufacture practiced at the Morse Iron Works, Erie, Pa. 3000 w. Foundry—Nov, 1907. No. 88020.

The Choice and Use of Fluxes for Soft Metals. Information in regard to fluxes for lead, tin, zinc and alloys. 3300 w. Brass Wld—Nov, 1907. No. 88518.

Gages.

See same title, under MEASUREMENT.

Galvanizing.

Old and New Methods of Galvanizing. Alfred Sang. Discusses hot galvanizing, pickling, the cold process, zinc dust, sherardizing, vapor galvanizing, and various applications. 10000 w. Pro Engrs' Soc of W Penn—Nov, 1907. No. 88528 D.

Tinning of Metals. Abstract of a special report on dangerous or injurious processes in the coating of metal with lead, or a mixture of lead and tin. Miss A. M. Anderson and T. M. Legge. 4800 w. Mech Engr—Nov. 16, 1907. Serial. 1st part. No. 88576 A.

Gear Cutters.

The Gould & Eberhardt Spur Gear Generator. Henry R. Cobleigh. Illustrated detailed description of the mechanism and its operation, stating also the advantages of the hobbing system. 2500 w. Ir Age—Nov. 7, 1907. No. 88136.

Grinder.

The Leland Universal Grinder. Illustrated detailed description of a machine for both wet and dry grinding. 2000 w. Ir Age—Nov. 7, 1907. No. 88135.

Grinding.

Some Grinding Problems. H. Darbyshire. Discusses the choice of a wheel for different shapes and texture of material, and related subjects. 5000 w. Engng—Nov. 15, 1907. No. 88579 A.

Jig Boring.

Economical Jig Work on the Milling Machine. E. A. Johnson. Illustrates and describes the tool equipment of the miller for jig boring. 1200 w. Am Mach—Vol. 30. No. 48. No. 88615.

Jigs.

See same title, under MACHINE ELEMENTS AND DESIGN.

Lapping.

Lapping Flat-Work and Gage Jaws. F. E. Shailor. An illustrated article giving suggestions of value. 2000 w. Mach, N Y—Nov, 1907. No. 88064 C.

Lathe.

An Automatic Lathe of Unique Design. A tool with worm-driven spindle and cam-operated carriage is illustrated and described. 1200 w. Am Mach—Vol. 30. No. 45. No. 88168.

Machine Tools.

See same title, under POWER AND TRANSMISSION.

Management.

Location of the Pattern Shop. Oscar

E. Perrigo. The first of a series of articles relating to operation and management. Ills. 1800 w. Foundry—Nov, 1907. Serial. 1st part. No. 88023.

The Machine Shop; Its Place in the Plant. Oscar E. Perrigo. Second of a series of articles on shop management and cost-keeping. Ills. 2500 w. Ir Trd Rev—Nov. 7, 1907. No. 88143.

The Organization of a Jig and Tool Department. John Younger. Describes briefly the system adopted in a large motor factory in England. 1200 w. Engng Oct. 25, 1907. No. 88104 A.

Profit Making in Shop and Factory Management. C. U. Carpenter. This tenth and last article of the series deals with the effective organization in the executive division. 2000 w. Engineering Magazine—Dec, 1907. No. 88630 B.

Molding.

Molding a Retort Casting. Jabez Nall. An illustrated account of difficulties with a poorly designed pattern and how they were overcome. 2500 w. Foundry—Nov, 1907. No. 88021.

Molding Machines.

Machine Molding for Railroad Castings. E. Ronceray. Illustrates and describes machines used. Discussion follows. 4500 w. Pro N Y R R Club—Oct. 18, 1907. No. 88264.

Molding-Machine Patterns and Work. Shows the adaptability of molding-machines to castings weighing from a few ounces to over a ton. Ills. 2500 w. Am Mach—Vol. 30. No. 45. No. 88166.

Some Limitations of the Molding Machine. E. H. Mumford. Considers limitations of machine functions. 3500 w. Pro Am Soc of Mech Engrs—Mid-Nov, 1907. No. 88604.

Molding Sand.

The Treatment and Handling of Molding Sand in Foundries (Ueber Aufbereitung und Beförderung des Formsandes in Giessereien). J. Kraus. The first part illustrates and describes various grinding and disintegrating devices and methods for separating out particles of iron. 2800 w. Serial. 1st part. Stahl u Eisen—Oct. 16, 1907. No. 88334 D.

Pipe Founding.

See Wrought Pipe, under MACHINE WORKS AND FOUNDRIES.

Planer.

A New Chandler 36-in. Planer. Illustrated description of a medium weight planer of special type. 2000 w. Ir Age—Nov. 28, 1907. No. 88631.

Safety Devices.

See same title, under INDUSTRIAL ECONOMY.

Shaping.

A New Method of Shaping Metals. Illustrated description of a process of roll and hammer swaging. 1200 w. Am Mach—Vol. 30. No. 45. No. 88169.

Shops.

The Green Engineering Co.'s Factory for the Manufacture of Mechanical Stokers. Illustrated detailed description of the plant at East Chicago. 2500 w. Ir Trd Rev—Nov. 28, 1907. No. 88607.

See also Shipbuilding, under MARINE AND NAVAL ENGINEERING; and Steel Works, under MINING AND METALLURGY, IRON AND STEEL.

Tempering.

Apparatus for Heat Treating Metals. Articles by various authors describing new appliances and methods. Ills. 6500 w. Am Mach—Vol. 30. No. 45. No. 88177.

Thermit Process.

See Welding, under MACHINE WORKS AND FOUNDRIES.

Vault Manufacture.

A Record-Breaking Armor Plate Vault. Illustrates and describes the design and construction of a very large vault. 2000 w. Mach, N Y—Nov, 1907. No. 88063 C.

Welding.

The Thermit Welding Process and Its Possibilities for Quick Repairs on Heavy Ordnance. Brief discussion of the application of this process to military requirements. Ills. 2200 w. Jour U S Art—Sept, 1907. No. 88294 D.

See also Boiler Repairs, under STEAM ENGINEERING.

Wrought Pipe.

Manufacture and Properties of Wrought Pipe. F. N. Speller. On the making, testing, characteristics, etc. Ills. 3000 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88133 N.

MATERIALS OF CONSTRUCTION.

Alloy Steels.

Titanium in Steel and Iron. Charles V. Slocum. Read before the Pittsburgh Found. Assn. Gives results of experimental investigations concerning the improvement to both steel and iron by the use of ferro-titanium. 2200 w. Ir Age—Nov. 14, 1907. No. 88249.

See also Improvements, under MATERIALS OF CONSTRUCTION.

Brass.

Brass Castings for Automobiles. E. F. Lake. Discusses the alloys used for special motor car parts. Ills. 2300 w. Foundry—Nov, 1907. No. 88025.

Cast Iron.

A Volumetric Study of Cast Iron. Henry M. Lane. Ills. On the volumetric composition of cast iron and its effect on properties. 1700 w. Pro Am Soc of Mech Engrs—Mid-Nov, 1907. No. 88602.

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High-Speed Steel.

Actual Results with High-Speed Steel. Fred H. Colvin. General review of results obtained. 1500 w. Am Mach—Vol. 30. No. 45. No. 88174.

Improvements.

The Advance in Materials for Machinery. E. F. Lake. General review of improvements made in metals, new metals, and alloys. 3500 w. Am Mach—Vol. 30. No. 45. No. 88175.

Lead Pipe.

Lead as a Material for Service Pipes. C. Powell Karr. Reviews the history of lead pipes, and discusses questions relating to their use. 2000 w. Met Work—Nov. 2, 1907. No. 88033.

Malleable Iron.

Malleable Cast-Iron. Bradley Stoughton. Describes the process of manufacture, the properties, uses, etc. 3800 w. Sch of Mines Qr—Nov., 1907. No. 88531 D.

MEASUREMENT.

Efficiencies.

See Gas Plant Testing, and Gas vs. Steam, under COMBUSTION MOTORS.

Gages.

Methods of Using Those Swedish Gages. Illustrates and describes appliances for using them in limit-gage work, as inside and outside caliper gages and in jig and fixture work. 1000 w. Am Mach—Vol. 30. No. 47. No. 88497.

Hardness.

An Instrument for Testing Hardness. Albert F. Shore. Illustrated description of an instrument for determining the relative and quantitative hardness of all metals. 4500 w. Am Mach—Vol. 30. No. 46. No. 88271.

Test Bars.

Casting Test Bars in Iron. Walter J. May. Suggestions for the making. 800 w. Prac Engr—Nov. 1, 1907. No. 88224 A.

Testing Castings.

See Foundry Materials, under MACHINE WORKS AND FOUNDRIES.

Testing Machine.

An Electrically Controlled Single-Lever Testing Machine and Some Torsion Tests. C. E. Larard. Describes the electrical method of control adopted in a new testing machine. Ills. 800 w. Elect'n, Lond—Nov. 8, 1907. No. 88472 A.

Water Meters.

See same title, under CIVIL ENGINEERING, WATER SUPPLY.

POWER AND TRANSMISSION.

Air-Compressors.

High-Speed Air-Compressors. Illustrated description of a new and simple type of small air-compressor. 800 w. Engng—Nov. 15, 1907. No. 88585 A.

Air Compressors (Luftcompressoren). Hans Wunderlich. A mathematical and theoretical discussion of the design of reciprocating compressors. Ills. 1700 w. Serial. 1st part. Elektrotech Rundschau—Oct. 16, 1907. No. 88347 D.

See also Electric Driving and Turbo-Compressors, under POWER AND TRANSMISSION.

Belt Tightening.

Automatic Belt-Tightening Devices (Selbstspannende Riemengetriebe). Rudolf Hundhausen. Illustrates and describes a number of arrangements of springs and levers for tightening belts. 2000 w. Zeitschr f Werkzeug—Oct. 5, 1907. No. 88350 D.

Chain Driving.

What Has Been Done in Chain Driving. F. L. Morse. The development of the high-speed chain drive is briefly considered. Ills. 900 w. Am Mach—Vol. 30. No. 45. No. 88171.

Electric Driving.

Electrically Driven Air Compressors. Andrew Floyd Bushnell. Illustrated brief descriptions of plants in Montana. 1000 w. Eng & Min Jour—Nov. 2, 1907. No. 88055.

Electric Driving in English Spinning Mills. T. Sington. Discusses the advantages to be derived by the adoption of electricity, especially referring to England 3500 w. Elec Wld—Nov. 9, 1907. No. 88191.

Hoisting Machinery.

See Cranes, under TRANSPORTING AND CONVEYING.

Machine Tools.

Driving Mechanism for Machine Tools. T. M. Lowthian. Illustrated description of a unique form of drive used in England. 700 w. Am Mach—Vol. 30. No. 46. No. 88272.

Horse-Power Values for Machine Tools. L. P. Alford. Considers percentages of friction loads, losses by electrical driving, and power curves. 900 w. Am Mach—Vol. 30. No. 46. No. 88273.

Producer Gas.

Power Transmission by Producer Gas. Charles E. Lucke. Considers the use feasible. 1500 w. Cassier's Mag—Nov, 1907. Special No. No. 88293 D.

Tidal Pumps.

Power from Tides. William O. Webber. Illustrates and describes a proposed plant for utilizing the power of tides by means of compressed air. 700 w. Engr, U S A—Nov. 1, 1907. No. 88040 C.

Tunneling Machinery.

See Tunnels, under CIVIL ENGINEERING, CONSTRUCTION.

Turbo-Compressors.

The General Electric Centrifugal Air

Compressor. Sanford A. Moss. Illustrated detailed description. 2500 w. Ir Age—Nov. 14, 1907. No. 88248.

Centrifugal Air Compressors for Low Pressures. Sanford A. Moss. Illustrated description, with some of the uses for which they are adapted. 1200 w. Am Mach—Vol. 30. No. 48. No. 88614.

STEAM ENGINEERING.

Accidents.

See Boiler Failures and Steam Pipes, under STEAM ENGINEERING.

Boiler Efficiency.

The Nature of True Boiler Efficiency. Walter T. Ray and Henry Kreisinger. Presents the more important results of experiments made, and gives a few laws governing the rate of heat absorption by boilers. Discussion. Ills. 14800 w. Jour W Soc of Engrs—Oct, 1907. No. 88525 D.

Boiler Failures.

Bulletin of the Accidents to Steam Apparatus during 1905 (Bulletin des Accidents d'Appareils à Vapeur survenus pendant l'Année 1905). Gives in tabular form a list of accidents, the nature of the installation, the circumstances and consequences of the accident and the probable cause. 4500 w. Ann d Ponts et Chauss —1907—III. No. 88311 E + F.

Boiler Inspection.

Regulations for the Management and Inspection of Steam Boilers (Regolamento per l'Esercizio e per la Sorveglianza delle Caldaie a Vapore). Standard rules adopted by the Italian Electrical Association. 2400 w. Serial. 1st part. Elettricita—Oct. 25, 1907. No. 88303 D.

Boiler Plant.

A Unique Boiler Plant. H. Cole Estep. Illustrated description of the Moran Co.'s plant for burning all the refuse from a Pacific-coast sawmill. 900 w. Power —Nov, 1907. No. 88012 C.

Boiler Plates.

Heat-Stresses and Formation of Cracks. Abstract translation of an article by Carl Sulzer, in the *Zeit. des Ver. Deut. Ing.* reporting investigations of a special case, with remarks on similar experience. Ills. 3800 w. Locomotive—Oct, 1907. No. 88619.

Boiler Repairs.

New Methods of Effecting Boiler Repairs. Harry Ruck-Keene. Abstract of a paper read at the Olympia Exhibition. Describes the oxy-acetylene and electric processes of effecting repairs by welding in place. Ills. 1700 w. Ir & Coal Trds Rev—Nov. 8, 1907. No. 88484 A.

Boilers.

Boiler Blow-Off Connections. R. T. Strohm. Illustrates and describes surface and bottom blow-offs. 1600 w. Elec Wld—Nov. 2, 1907. No. 88062.

The Parker Steam Generator. Report of the Franklin Institute on the invention of John C. Parker. Ills. 3000 w. Jour Fr Inst—Nov, 1907. No. 88252 D.

Boiler Scale.

Apparatus for Preventing the Formation of Coherent Scale in Boilers. Mr. Gölsdorf. Brief illustrated description. 500 w. Bul Int Ry Cong—Oct, 1907. No. 88119 E.

Coal Handling.

See same title, under TRANSPORTING AND CONVEYING.

Engines.

Some Features of Modern Corliss Engines. A. K. Spotton. Brief discussion of changes made necessary in the design of direct-connected engines. Ills. 1700 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88125 N.

See also Gas Engines, under COMBUSTION MOTORS; Steam Engines, under MARINE AND NAVAL ENGINEERING; and Hoisting Engines, under MINING AND METALLURGY, MINING.

Exhaust Steam.

See Turbines, under STEAM ENGINEERING.

Fuels.

The Combustion of Fuels. Gives tables which save much work in computations. 1200 w. Power—Nov, 1907. No. 88015 C.

Pulverized Coal and Its Industrial Applications. William D. Ennis. The first of two articles, considering the characteristics and preparation of the fuel, grinding, drying, conveying, etc, in the present number. Ills. 4000 w. Engineering Magazine. Dec, 1907. Serial. 1st part. No. 88627 B.

See also Boiler Plant, under STEAM ENGINEERING; and Oil Fuel, under MARINE AND NAVAL ENGINEERING.

Heat Radiation.

Heat Radiation Not Directly Proportional to Temperature Difference. Walter T. Ray. The practical engineering importance of Steffan and Boltzmann's radiation law is shown. 1200 w. Engr, U S A—Nov. 1, 1907. No. 88037 C.

Plant Design.

The Ratio of Heating Surface to Grate Surface as a Factor in Power Plant Design. Walter S. Finlay, Jr. Gives results of an investigation. 2000 w. Pro Am Inst of Elec Engrs—Nov, 1907. No. 88600 D.

Plant Efficiency.

See Gas vs. Steam, under COMBUSTION MOTORS.

Plants.

A Noteworthy, Small Steam Plant. J. E. Kent. Describes a small plant in Michigan which is moderate in cost,

and low in maintenance and operation expenses. 1000 w. Power—Nov., 1907. No. 88013 C.

See also Central Stations, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Steam Pipes.

The Protection of Steam Pipes from Accident. Arthur Herschmann. An illustrated study of automatic self-closing valves. 1700 w. Engineering Magazine —Dec., 1907. No. 88626 B.

Steam vs. Gas.

See Gas vs. Steam, under COMBUSTION MOTORS.

Superheating.

See Turbines, under MARINE AND NAVAL ENGINEERING; and Superheating, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Thermodynamics.

The Transformation of Heat into Work. Prof. Sidney A. Reeve. Describes graphically the conversion of various forms of energy, and gives a simple introduction to the temperature—entropy diagram. 4400 w. Power—Nov, 1907. No. 88010 C.

Early History of the Mechanical Equivalent of Heat. Reviews the development of the modern theory of the mutual convertibility of heat and mechanical energy. 4500 w. Locomotive—Oct, 1907. No. 88620.

Turbines.

Steam Turbines (Turbinas de Vapor). D. Alvaro Llatas. A general theoretical and mathematical discussion of their design and operation with notes on the leading features of the leading types. Ills. 6000 w. Serial. 2 parts. Revis Tech Indus—Aug. and Sept., 1907. No. 88300, each D.

The Development of Exhaust-Steam Turbines (Développement des Turbines à Vapeur d' Echappement). A. Rateau. A full discussion of their theory, design and operation, with descriptions of recent installations of the Rateau Turbine. Ills. 11000 w. Revue de Mécanique—Oct. 31, 1907. No. 88377 E + F.

The Determination of the Efficiency of Steam Turbines Without Measurement of Steam Consumption or Power (Die Bestimmung des Wirkungsgrades von Dampfturbinen ohne Dampfverbrauchs- und Leistungsmessung). Felix Langen. Detailed description of method. Tables. 2800 w. Zeitsch f d Gesamte Turbinenwesen—Oct. 19, 1907. No. 88360 D.

See also Central Stations and Turbo-Generator Tests, under ELECTRICAL ENGINEERING, GENERATING STATIONS; and Steam Turbines, under MARINE AND NAVAL ENGINEERING.

TRANSPORTING AND CONVEYING.

Aerial Tramway.

Aerial Wire Ropeway. Illustrated description of a ropeway for conveying coal and shale across a deep valley. 600 w. Engng—Oct. 25, 1907. No. 88099 A.

Coal Handling.

An Unusual Coal and Ash-Handling Equipment for a Power Station. Illustrated detailed description of the mechanical installation for the works of Armour & Co., of Chicago. 2000 w. Eng Rec—Nov. 9, 1907. No. 88195.

See also Ore Handling, under TRANSPORTING AND CONVEYING; and Coal Pocket, under CIVIL ENGINEERING; CONSTRUCTION.

Conveyors.

See Coal Handling and Ore Handling, under TRANSPORTING AND CONVEYING; and Hoisting, under MINING AND METALLURGY, MINING.

Cranes.

Floating Cranes. Trans. from *Prometheus*. An illustrated review of dock hoisting devices. 1500 w. Sci Am Sup—Nov. 2, 1907. No. 88018.

Power Required for Cranes and Hoists. Ulrich Peters. Gives formulae and methods of calculating the power required. 2500 w. Mach, N Y—Nov, 1907. No. 88066 C.

Electric v. Hydraulic Cranes. Gives examples showing the superiority of electric driving for crane work on the score of cost. 1400 w. Elec Rev, Lond—Oct. 25, 1907. No. 88091 A.

A 150-Ton Crane at the Shipyards of John Brown at Clydebank (Grue de 150-Tonnes des Chantiers Navals John Brown à Clydebank). Illustrated detailed description. Plate. 2000 w. Génie Civil—Oct. 12, 1907. No. 88327 D.

Dock Machinery.

A Modern Ship-Loading Installation (Eine Moderne Schiffs-Verladeeinrichtung). F. Stierlin. Illustrates and describes a recent installation at the French colony of New Caledonia. 2500 w. Serial. 1st part. Schweiz Bau—Oct. 26, 1907. No. 88345 B.

Dredges.

See same title, under CIVIL ENGINEERING, WATERWAYS AND HARBORS.

Hoisting.

See same title, under MINING AND METALLURGY, MINING.

Ore Handling.

Ore Handling Plant at South Bethlehem, Pa. Illustrated description of the car dumper and other features. 2500 w. Ir Age—Nov. 14, 1907. No. 88247.

Note on the Handling and Storage of Materials in Metallurgical Works (Quel-

ques Notes sur le Mouvement et l'Emmagasinement des Matières Premières dans les Usines Métallurgiques). Illustrates and describes coal and ore storage devices, conveyors, cranes, hoists, car-dumpers, etc., in use in Europe. 6000 w. All Indus—Oct, 1907. No. 88322 D.

Steam Shovels.

The Development and Importance of Steam Shovels (Die Entwicklung und Bedeutung der Dampfschaufeln). R. Richter. A discussion of their design and use and a description of various types. Ills. 7500 w. Zeitschr d Ver Deutscher Ing—Oct. 26, 1907. No. 88365 D.

MISCELLANY.

Aeronautics.

The Long Distance Balloon Races from St. Louis. An illustrated account. 1500 w. Sci Am—Nov. 2, 1907. No. 88017.

A New American Aeroplane. John Miller Bonbright. The latest invention of J. W. Roshon is described. Ills. 600 w. Sci Am—Nov. 16, 1907. No. 88243.

The Zeppelin Air-Ship. Editorial discussion of the construction and performances of this balloon. 1200 w. Engng—Oct. 25, 1907. No. 88102 A.

M. Henri Farman's Progress. Brief illustrated account of his successful flights at Issy on his aeroplane. 600 w. Auto Jour—Nov. 2, 1907. No. 88220 A.

The Esnault-Pelterie Flying Machine. Illustrations of flying machine and motor, with brief notes. 600 w. Auto Jour—Nov. 2, 1907. No. 88221 A.

The Latest French Aeroplanes and Their Records. Illustrated descriptions of the Pelterie monoplane, the Bréquet gyroplane, and the flights of M. Henri Farman. 300 w. Sci Am—Nov. 16, 1907. No. 88244.

Mechanics.

The True Principles of Mechanics. Sidney A. Reeve. Discusses the use of formulæ which are erroneous approximations and the necessity of teaching the principles of the science. 2000 w. Engr, Lond—Oct. 25, 1907. No. 88107 A.

MINING AND METALLURGY

COAL AND COKE.

Coke Drawing.

Coke Drawing Machines and Other Machinery for Use at the Ovens in the Manufacture of Coke. Walter W. Macfarren. An illustrated description of the progress of coke manufacture and the machines used. Discussion. 16500 w. Pro Engrs' Soc of W Penn—Nov, 1907. No. 88526 D.

Coke Ovens.

A Battery of Belgian Type Coke Ovens. Illustrated description of a new plant near New Salem, Pa. 2500 w. Ir Trd Rev—Nov. 14, 1907. No. 88298.

Coke Production.

Coke Production in 1906. Reviews the annual report of the United States Geological Survey. 2500 w. Ir Age—Nov. 7, 1907. No. 88137.

Coking By-Products.

Recovery of Benzol from Coke Oven Gases. An illustrated article showing the benefit derived from the recovery of the benzol, etc., direct, instead of by the distillation of the tar. 1200 w. Ir & Coal Trds Rev—Oct. 25, 1907. No. 88109 A.

Italy.

The Fossil Fuels of Italy and the Lignite Workings at Ribolla and Casteani in Grosseto Province (Ueber die fossilen Brennmaterialien Italiens und die Braunkohlenwerke Ribolla und Casteani in der Provinz Grosseto). Karl Stegl. The first part gives a record of Italian production of coal. Geological map. 2800 w. Serial. 1st part. Oest Zeitschr f Berg- u Huttenwesen—Oct. 19, 1907. No. 88338 D.

Low-Grade.

See Gas Producers, under MECHANICAL ENGINEERING, COMBUSTION MOTORS.

Montana.

Montana's Great Coalfields and Its Collieries. Floyd W. Parsons. Discusses the resources, development, transportation troubles, etc. Ills. 3000 w. Eng & Min Jour—Nov. 23, 1907. No. 88546.

Peat.

The Ziegler System of Peat Utilization. Describes the Ziegler plant at Beuerberg, in Upper Bavaria, which was opened in 1906, and its products. Ills. 4000 w. Engng—Nov. 15, 1907. No. 88580 A.

Supplies.

Our Coal Supplies. Edward W. Parker. Abstract of paper read before Am. Min. Cong. A discussion of how long the supply of coal will meet the increasing demands of commerce. 1500 w. Min Wld—Nov. 23, 1907. No. 88563.

The Fuel Situation in the Northwest. Floyd W. Parsons. Discusses the probability of another coal famine and the causes. Map. 2500 w. Eng & Min Jour—Nov. 2, 1907. No. 88058.

West Virginia.

Coal Mining in Southern West Virginia. Floyd W. Parsons. An illustrated de-

scription of this field and the methods of mining. Yields steam coal of superior quality. 2500 w. Eng & Min Jour—Nov. 9, 1907. No. 88184.

Wyoming.

The Coal-Mining Situation in Northern Wyoming. Floyd W. Parsons. Information concerning the quantity and quality of the coal, and its development. One seam shows small quantities of gold and silver. Ills. 3500 w. Eng & Min Jour—Nov. 16, 1907. No. 88404.

COPPER.

Australia.

New Copper Field in Australia. John Plummer. Brief account of the Mount Cangai field, in New South Wales. 1200 w. Min Wld—Nov. 16, 1907. No. 88422.

The Blue Bell Copper Mine. Lionel C. Ball. Gives the history, report of development, and description of the ore-bodies. 2800 w. Queens Gov Min Jour—Oct. 15, 1907. No. 88605 B.

Blast-Furnace Charging.

Furnace Charging. G. F. Beardsley. Refers to observations made at a copper plant where it became necessary to provide for the handling of an increased tonnage. 1200 w. Min & Sci Pr—Nov. 9, 1907. No. 88263.

British Columbia.

Some Ore Deposits of Similkameen District, B. C. Arthur Lakes. Illustrated description of this district and its mineralization with iron and copper ores, and gold-bearing pyrite. 1000 w. Min Wld—Nov. 16, 1907. No. 88424.

California.

The Copper Belt of California. Herbert Lang. Describes the interesting copper-bearing formation on the western flank of the Sierra Nevada range. Map. 5000 w. Eng & Min Jour—Nov. 16, 1907. Serial. 1st part. No. 88400.

Cold Rolling.

The Manufacture of Tubes and Shapes in the Cold (Fabrication à Froid des Tubes et Profiles). Pierre Breuil. Illustrates and describes the cold rolling and pressing of copper, aluminium and zinc as practiced by the Société Française de Métallurgie. 4500 w. Serial. 1st part. Génie Civil—Oct. 5, 1907. No. 88324 D.

Converters.

Modern Copper Converters, Hydraulically Operated. G. B. Shipley. Describes an installation being made at Kennet, Cal. 2200 w. Elec-Chem & Met Ind—Nov., 1907. No. 88435 C.

Extraction.

An Improved Method of Separating Copper. John A. Haralson. Diagrams and description of an apparatus for extracting metals from ore by leaching and precipitation, especially adapted for copper. 2000 w. Min Wld—Nov. 9, 1907. No. 88207.

North Carolina.

The Union Copper Mines of North Carolina. Francis C. Nicholas. An account of mines near Salisbury, N. C., where the oil separating process is being installed. 1800 w. Min Wld—Nov. 16, 1907. No. 88423.

Smelter Smoke.

Smelter Smoke, With a Discussion of Methods for Lessening Its Injurious Effects. L. S. Austin. Gives conclusions regarding the injury resulting. Ills. 3000 w. Min & Sci Pr—Nov. 23, 1907. No. 88611.

Smelter Stacks.

See Stacks, under CIVIL ENGINEERING, CONSTRUCTION.

Smelting.

See Blast Furnace Charging, under COPPER; and Copper, under ORE DRESSING AND CONCENTRATION.

Trade.

The Copper Situation. Horace J. Stevens. Reviews the past and present conditions, and thinks while the industry is sound, it will not receive a boom for a year or perhaps much longer. 2000 w. Min Jour—Oct. 26, 1907. No. 88097 A.

GOLD AND SILVER.

Assaying.

Experiments in Fire Assaying at the Redjang Lebong Mine, Sumatra. G. B. Hogenraad. Gives analyses of the ores, and an account of a new flux which is very satisfactory and cheap. General discussion. 4000 w. Jour Chem, Met, & Min Soc of S Africa. Sept, 1907. No. 88451 E.

Cobalt.

The Deloro Mining and Reduction Company. An illustrated article giving information in regard to present and past methods employed, and describing the plants for smelting Cobalt ores. 3000 w. Can Min Jour—Nov. 15, 1907. No. 88486.

Colombia.

Gold Mining in Colombia. Juan de la C. Posada. Information in regard to early and recent methods. Ills. 1200 w. Eng & Min Jour—Nov. 2, 1907. No. 88057.

Costa Rica.

Geology and Development of Aguacate Mines, Costa Rica. R. A. Crespi. Map and account of the gold mines and their development. 2000 w. Min Wld—Nov. 9, 1907. No. 88206.

Cyaniding.

History of Cyanidation. Philip Argall. Read before the Colorado Sci Soc. A review. 3500 w. Min & Sci Pr—Nov. 23, 1907. Serial. 1st part. No. 88612.

We supply copies of these articles. See page 715.

Dredging.

Dredging Beach Gravel Deposits Near Nome. John Power Hutching. Illustrates and describes methods tried and difficulties met. 4000 w. Eng & Min Jour—Nov. 23, 1907. No. 88542.

Nicaragua.

Mining in Nicaragua. A review with description of the mines and their development. 3000 w. Min Jour—Nov. 16, 1907. Serial. 1st part. No. 88578 A.

Peru.

The Gold and Silver-Bearing Veins of Huamachuco, Peru. F. Málaga Santolalla. Describes the country and the deposits. 2000 w. Min Jour—Nov. 9, 1907. No. 88475 A.

Philippines.

See Placers, under GOLD AND SILVER.

Placers.

Gold Placers of Nueva Ecija, in the Philippines. Gives the recent report of Mr. Maurice Goodman. 1500 w. Min Jour—Oct. 26, 1907. No. 88096 A.

Rand.

See same title, under CIVIL ENGINEERING, WATER SUPPLY.

Sea-Bottom.

The Presence of Gold and Silver in Deep-Sea Dredgings. Luther Wagoner. Reports assays made of deep-sea dredgings which indicated that the deep-sea bottom carries more gold than near the shore line. 300 w. Bul Am Inst of Min Engrs —Nov, 1907. No. 88636 C.

IRON AND STEEL.

Assaying.

The Determination of Tungsten in Steel in the Presence of Chromium (Ueber die Bestimmung von Wolfram im Stahl bei Gegenwart von Chrom). F. Willy Hinrichsen. On results of investigations made at the Imperial German Institute for Testing Materails. 1400 w. Stahl u Eisen —Oct. 2, 1907. No. 88332 D.

Austria.

See Steel Works, under IRON AND STEEL.

Blast-Furnace Charging.

The Charging of Blast Furnaces. E. H. Messiter. Describes the ore-bedding system designed by the writer. Ills. 4000 w. Min & Sci Pr—Oct. 26, 1907. No. 88009.

Blast-Furnace Gas.

The Utilization of the Waste Gases of Blast-Furnaces and of Coke Ovens in Metallurgical Works. Leon Greiner. Shows their importance as sources of motive power. Ills. 4000 w. Cassier's Mag—Nov., 1907. Special No. No. 88283 D.

The Blast Furnace as a Center of Power Production. B. H. Thwaite. Considers the benefits that might be secured, compares water and gas power, and related matters of interest. Ills. 6000 w. Cassier's Mag—Nov, 1907. Special No. No. 88280 D.

Blast-Furnace Gas as the Sole Source of Power in a Modern Steelworks (Le Gaz de Haut-Fourneau comme Source Unique d'Energie dans une Usine Sidérurgique Moderne). Francois Limbourg. Gives the results obtained in an actual plant which formerly employed some steam power. 4000 w. Rev de Métal—Oct., 1907. No. 88313 E + F.

Blast-Furnace Gas as a Sole Source of Motive Power in Modern Ironworks. F. Limbourg, in the *Revue de Metallurgie.* Gives particulars of the consumption of gas according as gas engines are used exclusively, or in conjunction with steam engines and turbines. 1800 w. Ir & Coal Trds Rev—Nov. 1, 1907. No. 88241 A.

Blast Furnaces.

The Formation of Accretions and of Accumulations of Graphite on the Blast-Furnace Hearth (Zur Frage der Entstehung von Bodensauen und Graphitansammlungen in Hochofengestellen). Ills. 2300 w. Serial. 1st part. Stahl u Eisen—Oct. 16, 1907. No. 88335 D.

Blowing Engines.

Blowing-Engines Driven by Blast-Furnace Gas; Details of Cylinders. Illustrates and describes particulars of engines of Continental make. 1200 w. Engng—Oct. 25, 1907. No. 88101 A.

Copper-Clad Steel.

Manufacture and Use of Copper-Clad Steel. Concerning the process perfected by J. Ferreol Monnot and the applications. 2300 w. Eng News. Nov. 14, 1907. No. 88556.

Duplex Process.

The Duplex Steel Making Process. B. C. Lauth. Plan and description of a proposed arrangement of plant, patented by T. S. Blair, Jr. 2000 w. Ir Age—Nov. 21, 1907. No. 88508.

Electro-Metallurgy.

The Electro-Metallurgy of Iron and Steel. S. Dushman. An illustrated article, discussing the extensive use of the electric furnace. 3500 w. Trans Eng Soc, Univ of Toronto—No. 20. No. 88131 N.

Electric Induction Furnaces and Their Application in the Iron and Steel Industry (Elektrische Induktionsöfen und ihre Anwendung in der Eisen- und Stahl-Industrie). V. Engelhardt. The first part of the serial gives a historical review of furnaces built on the induction principle. Ills. 1400 w. Serial. 1st part. Elektrotech Zeitschr—Oct. 31, 1907. No. 88374 D.

See also Lash Process, under IRON AND STEEL.

Germany.

The History of the Iron Industry in

the Harz District (Ueber die Geschichte der Eisenindustrie im Harz). Herr Geyer. 4000 w. Stahl u Eisen—Oct. 2, 1907. No. 88331 D.

See also Steel Works, under IRON AND STEEL.

Hollow Ingots.

Press for the Manufacture of Hollow Ingots. The invention of H. Harmet is illustrated and described. 1000 w. Mech Engr—Nov. 9, 1907. No. 88464 A.

Ingot Casting.

The Production of Steel Ingots for Large Crank-Shafts. A. Wiecke. An illustrated article dealing with the treatment of the steel from the pouring until completely set, giving a brief description of the process of forging a shaft. 2200 w. Ir & Coal Trds Rev—Nov. 8, 1907. Serial. 1st part. No. 88485 A.

Lash Process.

The Lash Steel Process and the Electric Furnace. An examination of this process and its working. 1200 w. Elec-Chem & Met Ind—Nov., 1907. No. 88434 C.

Metallography.

The Metallography of Pig Iron (Zur Metallographie des Roheisens). E. Heyn. and O. Bauer. A record of the results of investigations made at the Imperial German Institute for Testing Materials. Ills. 3300 w. Serial. 1st part. Stahl u Eisen—Oct. 30, 1907. No. 88336 D.

Ore Handling.

See same title, under MECHANICAL ENGINEERING, TRANSPORTING AND CONVEYING.

Pig Iron.

See Metallography, under IRON AND STEEL.

Rolling Mills.

New Saucon Plant of Bethlehem Steel Co. Illustrated description of new works at Bethlehem, Pa., comprising a rail mill, structural mill, and beam mill, the latter built under the Grey patents. 5800 w. Ir Trd Rev—Nov. 7, 1907. No. 88142.

The Illinois Steel Company's New Rail Mill. Illustrated description of a recent addition to the South Chicago Works. Plate. 2500 w. Ir Age—Nov. 28, 1907. No. 88632.

Scandinavia.

The Geological Relations of the Scandinavian Iron Ores. Prof. Hjalmar Sjögren. A geological study of the ores, their distribution, origin, classification, etc. 23000 w. Bul Am Inst of Min Engrs—Nov, 1907. No. 88633 D.

Steel Works.

Austrian Steel and Engineering Works. A review of the important works, with a survey of the available raw materials. 4000 w. Engr, Lond—Nov. 15, 1907. No. 88589 A.

The Frederich-Alfred Steelworks at Rheinhausen (Die Friedrich-Alfred-Hutte zu Rheinhausen). An elaborately illustrated descriptive article on a modern German works. 7000 w. Stahl u Eisen—Oct. 9, 1907. No. 88333 D.

LEAD AND ZINC.

Joplin District.

History of Smelting in the Joplin District. Doss Brittain. An illustrated account of the development of an important industry. 5500 w. Eng & Min Jour—Nov. 9, 1907. No. 88180.

The New Sheet Ground of the Joplin District. Doss Brittain. Explains the term "sheet ore," giving the theory of the formation, and an illustrated description of methods of mining and milling. 4500 w. Min Wld—Nov. 9, 1907. No. 88204.

Lead-Mining Chronology.

Chronology of Lead-Mining in the United States. W. R. Ingalls. 5000 w. Bul Am Inst of Min Engrs—Nov, 1907. No. 88637 C.

Lead Smelting.

The Electrolytic Treatment of Galena. Edward F. Kern and Herbert S. Auerbach. Discusses the metallurgical treatment of lead sulphide ores, and reports investigations made of the electrolytic treatment. 4500 w. Sch of Mines Qr—Nov, 1907. No. 88532 D.

Milling.

See Zinc Milling, under ORE DRESSING AND CONCENTRATION.

Missouri.

Sheet-Ground Mine in Southwest Missouri. D. T. Boardman. Illustrated description of mines at Webb City. 2000 w. Eng & Min Jour—Nov. 9, 1907. No. 88,183.

Wales.

Lead and Zinc Mines of North Wales. Edward Walker. Describes the mines, their management, production, etc. Ills. 3000 w. Eng & Min Jour—Nov. 9, 1907. No. 88182.

Zinc Assaying.

Assay of Zinc. Evans W. Buskett. Describes methods, discussing sources of error and means of guarding against them. 1500 w. Mines & Min—Nov, 1907. No. 87850 C.

Zinc Oxide.

Zinc Oxide: Its Properties and Uses. W. G. Scott. 2500 w. Min Wld—Nov. 9, 1907. Serial. 1st part. No. 88208.

Zinc Pigments.

Manufacture of Zinc Pigments. Evans W. Buskett. Description of the process used at Coffeyville, Kansas, for making zinc oxide and leaded zinc. 1400 w. Mines & Min—Nov, 1907. No. 87852 C.

We supply copies of these articles. See page 715.

Zinc Smelting.

Physical Factors in the Metallurgical Reduction of Zinc Oxide. Woolsey McA. Johnson. The reduction of zinc oxide and physical conditions affecting the efficiency are discussed. 3000 w. Bul Am Inst of Min Engrs—Sept, 1907. No. 87727 C.

Electric Zinc Smelting. Frederick T. Snyder. Describes the electric stack plant for the extraction of zinc with cost as compared with the retort plant. 1500 w. Min Rept—Oct. 24, 1907. No. 87921.

MINOR MINERALS.

Aluminium.

See same title, under ELECTRICAL ENGINEERING, TRANSMISSION.

Arsenic.

See Cobalt, under GOLD AND SILVER.

Barytes.

Geology of the Virginia Barite Deposits. Scotia. W. Spencer Hutchinson. Illustrated account of the deposits and workings. 900 w. Eng & Min Jour—Nov. 2, 1907. No. 88056.

Geology of the Virginia Barite-Deposits. Thomas Leonard Watson. Gives illustrated detailed description of the occurrence, and the conclusions deduced. 7000 w. Bul Am Inst of Min Engrs—Nov, 1907. No. 88635 C.

Cadmium.

Cadmium. Paul Speier. Its recovery, cadmium alloys and their use, and the production are considered. 3000 w. Min Jour—Nov. 9, 1907. No. 88476 A.

Magnesia Test.

Quantitative Field-Test for Magnesia in Cement Rock and Limestone. Charles Catlett. Gives a method worked out by J. J. Porter. 1700 w. Bul Am Inst of Min Engrs—Nov., 1907. No. 88634 C.

Marble.

See Quarrying, under MINING.

Oil Fields.

Relations of Oil Fields and Seismic Zones. M. L. C. Tassart. Trans. from *Comptes Rendus*. Gives results of comparisons made. 1000 w. Min Wld—Nov. 9, 1907. No. 88205.

Pyrites.

The Origin of Deposits of Pyrites. A. B. Wilmott. Deals with occurrences in Ontario. 3500 w. Can Min Jour—Nov. 1, 1907. No. 88069.

Talc.

The Henderson Talc Mine. Illustrated description of this mine at Madoc, Ontario. 1200 w. Can Min Jour—Nov. 1, 1907. No. 88067.

MINING.

Accidents.

Mining Accidents in 1906. Information from the General Report relating to mines and quarries in the United Kingdom. 4000 w. Col Guard—Oct. 25, 1907. No. 88098 A.

Aerial Tramway.

See same title, under MECHANICAL ENGINEERING, TRANSPORTING AND CONVEYING.

Air Compressors.

See same title, under MECHANICAL ENGINEERING, POWER AND TRANSMISSION.

Apex Law.

A Broad Apex. The decision of the U. S. Supreme Court in the case arising out of litigation at Bingham, Utah. Short editorial. 5000 w. Min & Sci Pr—Nov. 9, 1907. No. 88262.

A Remedy for the Law of the Apex. James Douglas. Read before the Am. Min. Cong. Recommends a voluntary contract for neighboring mine owners to apply to their surface the common-law rule. 1200 w. Eng & Min Jour—Nov. 23, 1907. No. 88545.

Australasia.

Mining in Australasia. H. L. Wilkinson. Information concerning the present condition of the mining industry in the several states. 2000 w. Min & Sci Pr—Nov. 16, 1907. No. 88512.

Blasting.

Can an Electrically-Ignited Shot Hang Fire? William Maurice. Shows that retarded ignition may occur in the electric detonator. 1400 w. Col. Guard—Nov. 1, 1907. No. 88233 A.

Drills.

The Electric-Air Drill. William L. Saunders. Details of construction and results are given. Ills. 3000 w. Bul Am Inst of Min Engrs—Nov., 1907. No. 88638 C.

Drilling.

See Excavation, under CIVIL ENGINEERING, CONSTRUCTION.

Electric Equipment.

An Electrically Equipped Lead Mine. Henry Floy. Illustrated detailed description of the installation of the St. Louis Smelting & Refining Co., at St. Francois, Mo. 2500 w. Eng News—Nov. 14, 1907. No. 88555.

Engineering Ethics.

To Young Men About to Become Mining Engineers. Courtenay De Kalb. Informal address before the students in the University of California, on some elements of success. 5000 w. Min & Sci Pr—Nov. 2, 1907. No. 88147.

Gas Power.

Gas Power as a Factor in Mine Economics. Archibald Burnett. Aims to show that, with slight modifications, gas engines could be used profitably in mining for all

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purposes except tramming. 3800 w. Eng & Min Jour—Nov. 16, 1907. No. 88401.

Hoisting.

Hoisting in the Yellow Dog Mine Near Webb City, Mo. Doss Brittain. Illustrated description of the conveyor-hoist, operated by electric motors, which is used. 1000 w. Eng & Min Jour—Nov. 16, 1907. No. 88402.

Hoisting Engines.

Winding Engine with Tandem Drums. Illustrated description of a fine direct-acting Corliss winding engine. Plate. 800 w. Engr, Lond—Nov. 1, 1907. No. 88240 A.

Long Range vs. Short Range Trip Gears for Winding Engines. R. H. Collingham. Gives results of efforts to arrive at a solution. Favorable to the short-range trip gear. 2700 w. Engr, Lond—Nov. 8, 1907. No. 88481 A.

New Safety Devices for Steam Hoisting Engines (Neuere Sicherheitsvorrichtungen für Dampffördermaschinen). J. Iversen. An illustrated detailed description of a new system of braking. 5500 w. Oest Zeitschr f Berg- u Hüttenwesen—Oct. 5, 1907. No. 88337 D.

Ore Handling.

See same title, under MECHANICAL ENGINEERING, TRANSPORTING AND CONVEYING.

Pumping Machinery.

See same title, under MECHANICAL ENGINEERING, HYDRAULICS.

Quarrying.

The Marble Quarries of Carrara. Day Allen Willey. Illustrated description of the deposits and the methods of working. 2000 w. Sci Am—Nov. 16, 1907. No. 88245.

Shaft Boring.

The Hydraulic Shaft-Boring Machine. Translated from *Glückauf*. Illustrated description of the present form of this machine and its operation. 2000 w. Col Guard —Nov. 1, 1907. No. 88232 A.

Surveying.

Mine Surveying. C. E. Morrison. With special reference to shaft surveying. 3500 w. Sch of Mines Qr—Nov, 1907. No. 88530 D.

Timber Preservation.

Prolonging the Life of Mine Timbers. John M. Nelson, Jr. Abstract of Forest Service Circular No. 111, giving results of a series of experiments made to determine the best method of prolonging the life of mine timber. 1600 w. Min Rept—Nov. 7, 1907. No. 88203.

Tunneling.

See Tunnels, under CIVIL ENGINEERING, CONSTRUCTION.

Ventilation.

An Improved System for Ventilating Mines. George Marie Capell. Illustrated description of an improved system of fan ventilation, patented Oct. 8, 1907. 1500 w. Min Wld—Nov. 16, 1907. No. 88421.

ORE DRESSING AND CONCENTRATION.

Copper.

The Steptoe Valley Mill and Smelter. Walter Renton Ingalls. Illustrates and describes a mill of 4000-tons daily capacity, and a 1000-ton smelter. 3200 w. Eng & Min Jour—Nov. 2, 1907. No. 88054.

Crushing.

Economy of Power in Crushing Ore. Ernest A. Hersam. Discusses principles that underlie economy in ore-crushing and pulverization. 7500 w. Min & Sci Pr—Nov. 16, 1907. No. 88513.

See also Tube Mills, under ORE DRESSING AND CONCENTRATION.

Elmore Process.

See North Carolina, under COPPER.

Hand-Jigs.

Jigging by Hand. Arthur C. Nahl. Illustrated description of jigs used in Mexico which were found serviceable. 1600 w. Min & Sci Pr—Nov. 2, 1907. No. 88146.

Slimes Treatment.

Slimes Agitation by Compressed Air. George G. Lyle. Illustrates and describes the Solis agitator which has given excellent results. 700 w. Min Rept—Nov. 21, 1907. No. 88561.

Tube Mills.

The Hardinge Conical Mill. H. W. Hardinge. Describes the sizing action of a conical pebble mill. 1500 w. Eng & Min Jour—Nov. 16, 1907. No. 88403.

Zinc Milling.

Improvements in Milling Missouri Zinc Ores. W. E. Ford. Discusses whether or not it would pay to treat further the tailings. 3000 w. Eng & Min Jour—Nov. 9, 1907. No. 88181.

Sludge-Mill Practice in the Missouri-Kansas District. Otto Ruhl. Describes the use of circle-tanks and of concentrating tables and the practice in saving fines. 2000 w. Min Rept—Nov. 7, 1907. No. 88202.

See also Joplin District, under LEAD AND ZINC.

MISCELLANY.

Alloys.

The Phenomena of Solidification and of Transformation in Alloys (Les Phénomènes de Solidification et de Transformation dans les Alliages). A. Portevin. An application of the phase law to a system of two bodies. Ills. 4000 w. Rev de Métal—Oct., 1907. No. 88312 E + F.

Bulgarian Law.

The Mining Law of Bulgaria. Trans-

lated from the French. Gives law as ratified Jan. 16, 1906. 2500 w. Min Jour—Nov. 2, 1907. Serial. 1st part. No. 88231 A.

Geological Survey.

Relations of Geological Survey to Mining Industry. George Otis Smith. Read before the Am. Min. Cong. Briefly considers the present work as a basis for statements regarding further possibilities. 4000 w. Min Wld—Nov. 23, 1907. No. 88562.

Mine Assessments.

Iron Mine Assessments in Minnesota. Dwight E. Woodbridge. A brief account of the methods of the tax commission in levying assessments, and of the results, so far as they affect individual mine operators. 1400 w. Eng & Min Jour—Nov. 23, 1907. No. 88543.

Review.

The Metal Trades in 1906 (Das Metallhüttenwesen im Jahre 1906). B. Neumann. Reviews production and prices of lead, copper, tin, zinc, gold, iron, coal, etc., for 1906 and of silver for 1905. 7500 w. Serial. 2 parts. Glückauf—Oct. 12 and 19, 1907. No. 88339 each D.

RAILWAY ENGINEERING

CONDUCTING TRANSPORTATION.

Electrification.

Organization Problems in Steam-Railroad Electrification. Howard S. Knowlton. Considers the changes in methods made necessary by the change in motive power. 3000 w. Engineering Magazine—Dec., 1907. No. 88623 B.

Signalling.

British Practice with Distant Signals. H. Raynar Wilson. Describes present practice. 2000 w. Ry & Engng Rev—Nov. 16, 1907. No. 88417.

Electric Signalling Installations at Euston and Crewe Stations. Illustrated detailed description. 2000 w. Elect'n, Lond—Oct. 25, 1907. Serial. 1st part. No. 88092 A.

Audible Distant Signals on the Great Western. Illustrated description of the apparatus and working of the installation on this English railway. 1500 w. R R Gaz—Nov. 15, 1907. No. 88274.

Automatic Block Signals on the Philadelphia & Western. A description of the apparatus installed. 2000 w. R R Gaz—Nov. 22, 1907. No. 88551.

The Philadelphia & Western Railroad's Automatic Electric Block Signal System. Illustrated detailed description. 2200 w. St Ry Jour—Nov. 2, 1907. No. 88072.

Note on the New Iron Posts Used by the Belgian State Railway for Wire Transmissions for Operating Signals. L. Weissenbruch and L. Kirsch. Illustrated description. 800 w. Bul Int Ry Cong—Oct, 1907. No. 88118 E.

Train Lighting.

See same title, under MOTIVE POWER AND EQUIPMENT.

MOTIVE POWER AND EQUIPMENT.

Brakes.

The Vacuum Brake and Slack Brake Gear. An account of valuable experiments on the effect of slackness in brake-rigging. 1800 w. Engng—Oct. 25, 1907. No. 88103 A.

Brake Valves.

The H 6 Brake Valve. G. W. Kiehm. Detailed description. 1200 w. Ry & Loc Engng—Nov., 1907. No. 88003 C.

Car Design.

Transportation by Rail. Abstract of an address by J. D. Twinberrow discussing some of the points in locomotive and car design now occupying the attention of railway engineers. 3300 w. Engr, Lond—Nov. 15, 1907. No. 88590 A.

Construction Cars.

New Outfit Cars on the Atchison, Topeka & Santa Fe. Illustrated detailed description. 1000 w. Ry Age—Nov. 15, 1907. No. 88420.

Locomotive Axles.

The Determination of the Loads on Locomotive Axles (Ueber die Bestimmung der Achsbelastungen bei Lokomotiven). A. Kutschera. A mathematical and theoretical discussion of methods of computing axle loads. Ills. 3200 w. Serial. 1st part. Zeitschr d Oest Ing u Arch Ver—Oct. 11, 1907. No. 88357 D.

Locomotive Design.

See Car Design, under MOTIVE POWER AND EQUIPMENT.

Locomotive Driving.

Locomotive Engine-Driving. A detailed account of how a locomotive is driven. 1200 w. Engr, Lond—Nov. 8, 1907. No. 88482 A.

Locomotive Failures.

Engine Failures. J. F. Whiteford. A discussion of what constitutes a failure, methods of reporting and comparing, and for improving conditions. 2000 w. Am Engr & R R Jour—Nov., 1907. No. 88042 C.

Locomotive Maintenance.

The Relation Between the Condition of

We supply copies of these articles. See page 715.

Motive Power and Its Repair. Clive Hastings. Endeavors to show the advantage of a systematic method of running and repairing engines. 2200 w. R R Gaz—Nov. 15, 1907. No. 88277.

Locomotives.

Rogers 4-6-2 A. & W. P. Illustrated description of a Pacific type engine. 700 w. Ry & Loc Engng—Nov., 1907. No. 88004 C.

Oldest Canadian Locomotive. Photograph and description of the "Samson," built in 1837. 800 w. Ry & Loc Engng—Nov., 1907. No. 88001 C.

Ten-Wheel Locomotive with Superheater for the Canadian Pacific. Illustrated description of engine with Vaughan superheater. 800 w. R R Gaz—Nov. 22, 1907. No. 88550.

Decapod Locomotive with Combination Chamber. Illustrates and describes engines recently built for the Buffalo, Rochester & Pittsburgh Ry. 700 w. Ry Mas Mech—Nov., 1907. No. 88297.

Twelve-Wheel Freight Locomotive. Illustrated description of 4-8-0 type locomotives for the Norfolk & Western Ry. 900 w. Am Engr & R R Jour—Nov., 1907. No. 88044 C.

Pacific Type Locomotive. Illustrated description of an engine for heavy passenger service on the New York, New Haven, & Hartford. 900 w. Am Engr & R R Jour—Nov., 1907. No. 88043 C.

Pacific Locomotives for the New York, New Haven & Hartford. Illustrates and describes these 4-6-2 engines, the first with trailing wheels to be built for this road. 1200 w. R R Gaz—Nov. 8, 1907. No. 88153.

Balanced Compound Atlantic Locomotive for the Chicago, Milwaukee & St. Paul. Illustrated description. 700 w. R R Gaz—Nov. 15, 1907. No. 88278.

New Locomotives for New York, Chicago, & St. Louis. Illustrates and describes types for passenger, freight, and switching service. 1300 w. Ry Age—Nov. 15, 1907. No. 88419.

Four-Wheel Switching Locomotive. Illustrated description of an engine for use in the yards of a manufacturing company. 500 w. R R Gaz—Nov. 8, 1907. No. 88156.

Eight-Coupled Mineral Locomotives; Hull and Barnsley Railway. Illustrated description. 600 w. Engng—Nov. 15, 1907. No. 88582 A.

Locomotive Stokers.

The Crosby Locomotive Mechanical Stoker. Illustrated detailed description. 2000 w. Ry Mas Mech—Nov., 1907. No. 88296.

The Hayden Locomotive Stoker. Illustrated description of a stoker used on the Erie R. R. 800 w. Ry Age—Nov. 8, 1907. No. 88209.

Locomotive Tests.

Tests of the Resistance of a 3/3 Coupled Locomotive (Untersuchung der Widerstand einer 3/3-gekuppelten Lokomotive). R. Sanzin. Describes the method and results. Ills. 4000 w. Zeitschr d Ver Deutscher Ing—Oct. 26, 1907. No. 88366 D.

Steam vs. Electricity.

Comparative Performance of Steam and Electric Locomotives. Albert H. Armstrong. A study of steam and electric locomotives with technical comparison of their performance, showing reasons for the electrification of steam lines. 7500 w. Pro Am Inst of Elec Engrs—Oct., 1907. No. 88253 D.

Discussion, by J. E. Muhlfeld, of the paper by Max Toltz, "Steam Locomotives *versus* Electric Locomotives." 3000 w. Pro N Y R R Club—Oct. 18, 1907. No. 88265.

Superheaters.

The First Steam Superheaters. Charles R. King. Illustrated descriptions of early types. 2000 w. R R Gaz—Nov. 1, 1907. No. 88027.

Superheating.

The Application of Highly Superheated Steam to Locomotives. Robert Garbe. This first article of a series considers the advantages of superheated steam, size of superheaters, hauling capacity of superheated steam locomotives, etc. 3500 w. Engr, Lond—Oct. 25, 1907. Serial. 1st part. No. 88105 A.

Tires.

Steel Tires—Causes of Defects and Failures. George L. Norris. Discusses defects in steel, conditions of service, etc. Ills. General discussion. 8800 w. Pro W Ry Club—Oct. 15, 1907. No. 88219 C.

Train Lighting.

Methods of Electric Lighting for Railway Trains. Dugald C. Jackson. Gives a summary of results and data obtained in a series of tests of different apparatus. Discussion. 12500 w. Jour W Soc of Engrs—Oct., 1907. No. 88524 D.

NEW PROJECTS.

Construction.

See Construction Cars, under MOTIVE POWER AND EQUIPMENT; and Excavation, under CIVIL ENGINEERING, CONSTRUCTION.

Grading Contracts.

No-Classification Contracts for Railroad Graduation. F. Lavis. An account of a case where it was necessary to resort to arbitration to settle differences in regard to a contract on the no-classification basis. 3500 w. Engng-Con—Nov. 6, 1907. No. 88150.

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Nevada Northern.
The Nevada Northern Railway. Illustrations, with brief description of a new line of importance in the development of the copper-mining industry of Nevada. 800 w. Ry Age—Nov. 22, 1907. No. 88557.

Surveying.
Railway Surveys. Andrew F. Macallum. Notes and suggestions for the work. 4000 w. Trans Eng Soc, Univ of Toronto —No. 20. No. 88129 N.

PERMANENT WAY AND BUILDINGS.

Car Dumping.
See Ore Handling, under MECHANICAL ENGINEERING, TRANSPORTING AND CONVEYING.

Construction.
See Reconstruction, under PERMANENT WAY; and Construction, under NEW PROJECTS.

Earth Slides.
Earth Slides on Railway Work. H. Rohwer. Abstract of a paper in Bul. No. 90, of the Am. Ry. Engng. & Main. of Way Assn. 1500 w. Eng News—Nov. 21, 1907. No. 88507.

Maintenance of Way.
Why Efficient Track Work is Skilled Labor. W. M. Camp. Read at convention of Roadmasters & Main. of Way Assn. Presents arguments to show the need of skill in the work. 2500 w. Ry & Engng Rev—Nov. 16, 1907. No. 88418.

Oil House.
A Modern Oil House. Illustrated description of a building for the Great Northern Ry. at St. Paul, Minn. 2000 w. Ry Mas Mech—Nov., 1907. No. 88295.

Rails.
Heavy-Rail Sections in America. Editorial discussion of the causes of the large number of rail failures and the efforts being made to improve the rails. 4000 w. Engng—Nov. 15, 1907. No. 88584 A.

Rail Stresses.
Lateral Thrust of Car Wheels Against the Rail. George L. Fowler. From advance sheets of a report made to the Schoen Steel Wheel Co. Illustrated account of tests made. 3500 w. R R Gaz —Nov. 15, 1907. No. 88276.

Reconstruction.
Double-Track Work Through Eagle River Canyon, Denver & Rio Grande R. R. Brief illustrated description. 1200 w. Eng Rec—Nov. 16, 1907. No. 88406.

The Rex-Red Cliff Double Track Construction on the Denver & Rio Grande R. R. Illustrated description of interesting details of construction. 1200 w. Eng News—Nov. 21, 1907. No. 88502.

Six-Tracking and Reconstruction of the Harlem River Branch of the New York, New Haven and Hartford R. R. Illustrated description of improvements in progress. 3500 w. Eng Rec—Nov. 9, 1907. No. 88194.

Roundhouses.
An Important Development in Roundhouse Design and Operation. Illustrates and describes improvements in design and operation introduced at Dilworth, Minn., on the Northern Pacific Ry. 1200 w. Am Engr & R R Jour—Nov., 1907. No. 88041 C.

Signalling.
See same title, under CONDUCTING TRANSPORTATION.

Timber Preservation.
See same title, under CIVIL ENGINEERING, MATERIALS OF CONSTRUCTION.

Tunnels.
See same title, under CIVIL ENGINEERING, CONSTRUCTION.

TRAFFIC.

Car Efficiency.
Commissioner Clark on the Freight Car Situation. Hon. E. E. Clark's address at Chicago, Oct. 25. 2000 w. R R Gaz—Nov. 8, 1907. No. 88154.

Explosives.
The Bureau of Explosives. From a report of the committee on transportation of explosives to the American Ry. Assn., Oct. 30, 1907. 8500 w. R R Gaz—Nov. 8, 1907. No. 88157.

Refrigeration.
The Present Status of Mechanical Refrigeration in Railroad Work. Jos. H. Hart. Discusses present conditions, the reasons, and the application of mechanical refrigeration in this field. 2000 w. R R Gaz—Nov. 22, 1907. No. 88549.

Mechanical Refrigeration Adapted to Railway Transportation. Dr. Joseph H. Hart. Reviews refrigerating systems in use, and explains the economy of large plants charging brine-cooled cars. 3000 w. Engineering Magazine—Dec., 1907. No. 88629 B.

MISCELLANY.

American Railways.
Some Phases of the American Railroad Problem. Stuyvesant Fish. Address at Columbia Univ. Reviews the conditions under which early railways were constructed and their history. 5500 w. Sch of Mines Qr—Nov., 1907. No. 88529 D.

European Railways.
Observations on European Railroads. A. T. Perkins. On the methods, appliances, and facilities of foreign railways. Ills. Discussion. 6500 w. Pro St Louis Ry Club—Oct. 11, 1907. No. 88008.

French Railways.
French Railway Economics. Editorial review of conditions in France and the *personnel* of the principal companies. 2200 w. Engng—Nov. 15, 1907. No. 88583 A.

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STREET AND ELECTRIC RAILWAYS

Accounting.

Electric Tramway Accounting and Finance. The first of a series of articles considering the general characteristics of such accounts. 2200 w. Elec Rev, Lond—Nov. 1, 1907. Serial. 1st part. No. 88228 A.

Brakes.

The Determination of the Correct Braking Power to Be Applied to Electric Cars and Locomotives. H. M. Prevost Murphy. Develops formulæ and illustrates their use. 1600 w. Elec Ry Rev—Nov. 23, 1907. No. 88560.

Foundation Brake Gear Design for Electric Railway Cars. Fred Heckler. Read before the Cent. Elec. Ry. Assn. Discusses the brake problem, mechanical requirements, etc. 2000 w. Elec Ry Rev—Nov. 23, 1907. No. 88558.

Foundation Brake-Gear Design for Electric Railway Cars. Fred Heckler. Read at meeting of Cent. Elec. Ry. Assn. Discusses the proper proportion between air pressure, cylinder piston area and leverage, the mechanical requirements, etc. Ills. 3500 w. St Ry Jour—Nov. 30, 1907. No. 88670.

Brooklyn.

The Livingston Street Railway Improvement for Relieving Brooklyn Rush-Hour Traffic. An account of arrangements for diverting some of the cars from Fulton St. between the Borough Hall and Flatbush Ave. 1500 w. St Ry Jour—Nov. 16, 1907. No. 88416.

Cars.

High-Speed Cars for the Aurora, Elgin & Chicago Railroad. Illustrated description of well-built passenger cars. 700 w. Elec Ry Rev—Nov. 16, 1907. No. 88436.

Conduit System.

The "Robrow" Conduit System as Adopted for Benares Tramways. A proposed installation in India of a shallow conduit system with surface collection is illustrated and described. 3000 w. Tram & Ry Wld—Nov. 7, 1907. No. 88473 B.

Electric Tramways for Benares. Illustrated description of the Robrow shallow-conduit system adopted. 2500 w. Elec Engr, Lond—Nov. 22, 1907. No. 88701 A.

Controller.

The Electrical Controller. W. B. Kouwenhoven. An explanation of its operation. 2800 w. Ry & Loc Engng—Dec., 1907. No. 88683 C.

Electrification.

The Fort Dodge, Des Moines & Southern Railway of Iowa. Illustrates and describes the electrification of a steam road, with new interurban construction. 1600 w. St Ry Jour—Nov. 30, 1907. No. 88669.

See also same title, under RAILWAY ENGINEERING, CONDUCTING TRANSPORTATION.

Europe.

Alternating-Current Electric Traction on European Railways (La Traction Electrique par Courant Alternatif Simple sur les Chemins de Fer en Europe). M. Henry. The first part of the serial discusses the Siemens-Schuckert single-phase system. Ills. Serial. 1st part. 2800 w. Electricien—Oct. 12, 1907. No. 88320 D.

Fares.

Interurban Fares. Theodore Stebbins. Read before the Am. St. & Int. Ry. Assn. Discusses the conditions that should form a basis for fixing the rates. 3800 w. R R Gaz—Nov. 15, 1907. No. 88275.

Fire Car.

Fire Car for the South Side Elevated Railroad. Illustrated description. 600 w. Elec Ry Rev—Nov. 9, 1907. No. 88187.

Germany.

The Munster-Schlucht Electric Railway. E. Ommeganck. Illustrates and describes a combined rack and adhesion scheme. 1300 w. R R Gaz—Nov. 29, 1907. No. 88647.

Interurban.

Interurban Railways. Hugh J. M'Gowan. Abstract of address before the Nat. Business League of America. Considers the present and future development. 1600 w. Elec Ry Rev—Nov. 30, 1907. No. 88675.

The Indianapolis & Louisville 1,200-Volt Railway. Illustrated description of this high-speed interurban line. 2500 w. Elec Ry Rev—Nov. 30, 1907. No. 88674.

Legislation.

Electric Railway and Public Service Legislation. Henry J. Pierce. From an address at Madison Square Garden, New York City, Oct. 1, 1907. 2000 w. R R Gaz—Nov. 29, 1907. No. 88645.

Locomotives.

Electric Locomotives for the Pennsylvania Railroad. Illustrates and describes the engines being tested on the West Jersey & Seashore division with a view to determining the track stresses and other questions in heavy electric traction. 1000 w. R R Gaz—Nov. 22, 1907. No. 88552.

See also Steam vs. Electricity, under RAILWAY ENGINEERING, MOTIVE POWER AND EQUIPMENT.

Maintenance.

Analysis of the Cost and Methods of Electric Railway Maintenance. Albert

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Herrick. Abstract of paper read before the Cent. Elec. Ry. Assn. Considers causes that lead to high maintenance costs. 3000 w. Elec Ry Rev—Nov. 23, 1907. No. 88559.

Motor Cars.

The Single-Phase Thomson-Houston Motor Cars (Automotrici A. E. G. Thomson-Houston per Trazione Monofase). Illustrated detailed description of the motor cars in use on the Blankenese-Ohlsdorf line in Germany. 2000 w. Serial. 1st part. Elettricita—Oct. 11, 1907. No. 88302 D.

Motors.

See Railway Motors, under ELECTRICAL ENGINEERING, DYNAMOS AND MOTORS.

Motor Suspension.

The Suspension of Motors on Tramcars. Brief discussion of the unsatisfactory methods in use, and the remedy. 900 w. Elec Engr, Lond—Oct. 25, 1907. No. 88089 A.

Power Stations.

See Central Stations and Hydro-Electric, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Quebec.

The Montmorency Division of the Quebec Railway, Light & Power Company. Illustrated description of a combined steam and electric line. 2500 w. St Ry Jour—Nov. 16, 1907. No. 88415.

Rack-Rail.

See Germany, under STREET AND ELECTRIC RAILWAYS.

Rail Bonding.

Contact Resistance in Connection with Rail Bonding. A study made with special reference to compression bonds. 1500 w. Jour Worcester Poly Inst—Nov., 1907. No. 88260 C.

Rail Corrugation.

Report on Rail Corrugation, Presented at the Eleventh Annual Meeting of the German Street and Interurban Railway Association. Ills. 3500 w. St Ry Jour—Nov. 9, 1907. No. 88201.

Corrugations on the Upper Surface of Rail Heads. Abstract report of a committee presented to the German Tramways & Light Rys. Assn. 2500 w. Elect'n, Lond—Nov. 15, 1907. No. 88573 A.

Track Construction and Corrugation. An illustrated description of experiences in Boston and Philadelphia. 4000 w. Tram & Ry Wld—Oct. 3, 1907. No. 87824 B.

The Hardness of Corrugated Rails. George L. Fowler. A report of investigations made which eliminate variations in hardness as a cause of rail corrugation. 1200 w. St Ry Jour—Oct. 5, 1907. No. 87493.

Rail Corrugation. A. L. C. Fell. Abstract of a report to the London County Council on the possible causes and suggesting remedies. 4200 w. Elec Engr, Lond—Oct. 4, 1907. No. 87586 A.

Storage Yard.

The New Sullivan Square Elevated Storage Yard of the Boston Elevated Railway. Plan, sections, and description. 1200 w. St Ry Jour—Nov. 23, 1907. No. 88535.

Sub-Stations.

Portable Sub-Station for Rochester and Sodus Bay Railway. B. C. Amesbury. Illustrated description of a sub-station for use at any points on the line which may temporarily require special power. 900 w. St Ry Jour—Nov. 2, 1907. No. 88071.

See also same title, under ELECTRICAL ENGINEERING, GENERATING STATIONS.

Switzerland.

Electric Traction in Switzerland During 1907 (La Trazione Elettrica in Isvizzera nell' Anno 1907). S. Herzog. A review of progress and a discussion of new projects. 1700 w. Serial. 1st part. Industria—Oct. 13, 1907. No. 88304 D.

Terre Haute, Ind.

Recent Interurban Improvements at Terre Haute. An illustrated account of improvements in power supply and service and in local lighting. 2000 w. Elec Ry Rev—Nov. 9, 1907. No. 88186.

Third Rail.

Standard Location for Third Rail Conductors. Abstract of committee report presented at the Oct. meeting of the Am. Ry. Assn. Ills. 1200 w. R R Gaz—Nov. 8, 1907. No. 88155.

Track Construction.

Some Recent Street Railway Track Construction. Describes recent methods of construction in Chicago, and in Indianapolis, Kansas City and Toronto. Ills. 2500 w. Eng News—Nov. 7, 1907. No. 88111.

Track Construction in Some Southern Cities. Illustrates and describes recent work in San Antonio, Houston, and Chattanooga. 1500 w. St Ry Jour—Nov. 23, 1907. No. 88534.

Vienna-Baden.

The Vienna-Baden Electric Railroad (Die elektrische Bahn Wien-Baden). Leo Kadrnozka. The first part of the serial describes the location and profile of the line. Ills. 2500 w. Serial. 1st part. Elektrotech u Maschinenbau—Oct. 20, 1907. No. 88351 D.

Wales.

Llandudno and Colwyn Bay Tramways. Illustrates and describes a line in Wales to connect sea-side resorts and some interurban territory. 1400 w. Tram & Ry Wld—Nov. 7, 1907. No. 88474 B.

We supply copies of these articles. See page 715.

EXPLANATORY NOTE—THE ENGINEERING INDEX.

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter N is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

Serial publications are indexed on the appearance of the first installment.

SPECIAL NOTICE.—To avoid the inconvenience of letter-writing and small remittances, especially from foreign countries, and to cheapen the cost of articles to those who order frequently, we sell coupons at the following prices:—20 cts. each or a book of twelve for $2.00; three books for $5.00.

Each coupon will be received by us in payment for any 20-cent article catalogued in the Index. For articles of a higher price, one of these coupons will be received for each 20 cents; thus, a 40-cent article will require two coupons; a 60-cent article, three coupons; and so on. The use of these coupons is strongly commended to our readers. They not only reduce the cost of articles 25 per cent. (from 20c. to 15c.), but they need only a trial to demonstrate their very great convenience—especially to engineers in foreign countries, or away from libraries and technical club facilities.

Write for a sample coupon—free to any part of the world.

CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED.

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the Index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated: W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. e d Arch. Ital. *w.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brit. Columbia Mining Rec. *m.* Victoria, B. C.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bulletin Univ. of Kansas. *b-m.* Lawrence.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *m.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Compressed Air. *m.* New York.
Comptes Rendus de l'Acad. des Sciences. *w.* Paris.
Consular Reports. *m.* Washington.

Deutsche Bauzeitung. *b-w.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Review. *w.* Chicago.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Electrochemical and Met. Industry. *m.* N. Y.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elektrotechnische Zeitschrift. *w.* Berlin.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineer. *s-m.* Chicago.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Far Eastern Review. *m.* Manila, P. I.
Fire and Water. *w.* New York.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Gesundheits-Ingenieur. *s-m.* München.
Giorn. dei Lav. Pubb. e d Str. Ferr. *w.* Rome.
Glaser's Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Ice and Refrigeration. *m.* New York.
Industrial World. *w.* Pittsburg.
Ingenieria. *b-m.* Buenos Ayres.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron and Steel Trades Journal *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal of Electricity. *m.* San Francisco.
Journal Franklin Institute. *m.* Philadelphia.
Journal Royal Inst. of Brit. Arch. *s-qr.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A.
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Journal of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Madrid Cientifico. *t-m.* Madrid.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *w.* Cleveland, U. S. A.
Men. de la Soc. des Ing. Civils de France. *m.* Paris.
Métallurgie. *w.* Paris.
Minero Mexicano. *w.* City of Mexico.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Reporter. *w.* Denver, U. S. A.
Mittheilungen des Vereines für die Förderung des Local und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nature. *w.* London.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochenschr. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Popular Science Monthly. *m.* New York.
Power. *m.* New York.
Practical Engineer. *w.* London.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Quarry *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railroad Gazette. *w.* New York.
Railway Age. *w.* Chicago.
Railway & Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revista d Obras. Pub. *w.* Madrid.
Revista Tech. Ind. *m.* Barcelona.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Revue Technique. *b-m.* Paris.
Rivista Gen. d Ferrovie. *w.* Florence.
Rivista Marittima. *m.* Rome.
Schiffbau. *s-m.* Berlin.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Street Railway Journal. *w.* New York.
Technograph. *yr.* Urbana, Ill.
Technology Quarterly. *qr.* Boston, U. S. A.
Tijds v h Kljk. Inst. v Ing. *qr.* Hague.
Tramway & Railway World. *m.* London.
Trans. Am. Ins. Electrical Eng. *m.* New York.
Trans. Am. Ins. of Mining Eng. New York.
Trans. Am. Soc. Mech. Engineers. New York.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Transport. *w.* London.
Verkehrstechnische Woche und Eisenbahntechnische Zeitschrift. *w.* Berlin.
Wood Craft. *m.* Cleveland, U. S. A.
Yacht. *w.* Paris.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagon Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschrift für Elektrochemie. *w.* Halle a S.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

Blacksmithing.

The Blacksmith's Guide. By J. F. Sallows. Size, 7 by 4½ in.; pp. 160. Ills., 165. Price, cloth, $1.50; leather, $2. Brattleboro, Vt.: The Technical Press.

A book for blacksmiths, machinists and toolmakers, containing instructions on forging, welding, hardening, tempering, treatment of high-speed steel, case hardening, annealing, coloring, brazing and general blacksmithing. The processes outlined are those used by the author during his twenty-seven years' experience as a blacksmith in nearly all kinds of shops, and they are of proved value as time and money savers. A great deal of valuable practical information is contained in a small compass and the book can be confidently recommended both to foremen blacksmiths and to the young mechanic anxious to improve himself in his trade.

Electrical Equipment.

Electrical Installations of the United States Navy. By Commander Burns T. Walling, U. S. N., and Julius Martin, E. E. Size, 9 by 6 in.; pp., 648. Ills. Price, $6. Annapolis, Md.: The United States Naval Institute.

A manual of the latest approved material, including its use, operation, inspection, care and management, and method of installation on board ship, originally published in the Journal of the United States Naval Institute and now issued in book form. It discusses exhaustively incandescent and arc lamps and search lights, wire and wiring appliances, generator and motor installation, operation and inspection, the various applications of electric motors aboard ship, and facilities for interior and exterior communication. The book by no means confines itself to mere description. While machines, appliances and instruments are described in detail, the main object is to give an idea of the practical details of their installation, operation and maintenance and to this end attention is paid to constructional features. The book is interesting to engineers generally as showing the immense importance of electricity on shipboard, and will prove of great value as a handbook for those whose duties require an intimate knowledge of the applications of electricity in the modern warship.

Gas Manufacture.

The Chemistry of Gas Manufacture. By Harold M. Royle. Size, 9 by 6 in.; pp., xv, 328. Ills. Price, $4.50. New York: The Norman W. Henley Publishing Company.

A practical treatise for the use of gas engineers, gas managers and students dealing entirely with the chemistry of gas manufacture to the exclusion of details of manufacturing. A knowledge of the elementary truths and processes is presupposed and the different subjects are treated in as concise a manner as possible. The book is intended to be a manual covering questions and points likely to arise in the ordinary course of the duties of the engineer or manager of a gas works not large enough to necessitate the employment of a separate chemical staff. The subjects treated are: preparation of standard solutions, coal analysis, testing and regulation of furnaces, products of carbonisation, analysis of crude coal gas, analysis of lime, ammonia, analysis of oxide of iron, naphthalene, analyses of fire-bricks and fire-clay, weldon, and spent oxide, photometry and gas testing, and carburetted water-gas. A large amount of useful information is given in the three appendices, consisting of selected extracts from matter previously published, including examples of official regulations and instructions for testing coal gas for illuminating power, calorific value and impurities, tables, data, statistics, etc.

Grinding.

Grinding and Lapping. By Joseph V. Woodworth. Size, 9 by 6 in.; pp., ix, 162. Ills. Price, $2. New York and London: Hill Publishing Company.

A comprehensive work on the design, construction and operation of grinding and lapping tools and devices written in a very practical manner and intended for the use of the mechanic. The book is divided into five sections. The first deals with grinding operations, describing conditions, rules, methods, processes, machines and attachments for accurate grinding, and the use and preparation of abrasives. In like manner the second section discusses lapping practice, describing the construction and use of tools and processes for finishing gages, tools, dies and machine parts to accurate dimensions.

In the third section grinding fixtures and jigs are considered, particularly their construction, use and operation for finishing repetition work and articles of metal, small hardened and tempered steel parts and special work. Sections 4 and 5 treat of the heat treatment of steel, the former describing the hardening and tempering of interchangeable tool steel parts of delicate structure which require to be ground and lapped afterwards, and the latter discussing the percentage of carbon crucible-steel parts and tools should contain, temper colors to which they should be drawn, and degrees of heat for giving them proper tempers. A valuable feature of the book is that all devices and processes mentioned are illustrated in an unusually clear manner.

Mathematics.

A Course in Mathematics. By Frederick S. Woods and Frederick H. Bailey. Volume I, containing algebraic equations, functions of one variable, analytic geometry, differential calculus. Size, 8½ by 6 in.; pp., 385. Diagrams. Price, $2.40. New York and London: Ginn and Company.

The first of two volumes of a course in mathematics designed for the use of students in the first and second years at engineering schools, the first volume containing the work of the first year. The course is designed to present in a consecutive and homogeneous manner an amount of material generally given in distinct courses under the various names of algebra, analytic geometry, differential and integral calculus, and differential equations. The authors' claim to novelty lies in the fact that the traditional divisions of mathematics into distinct subjects are ignored and the principles of each subject are introduced as needed and the subjects developed together. It is hoped that this arrangement will give the student a better grasp of mathematics as a whole, and of the interdependence of its various parts, and to accustom him to use, in later applications, the method best adapted to the problem in hand.

Pumps.

Notes on the Construction and Working of Pumps. By Edward C. R. Marks. Size, 7 by 5 in.; pp., viii, 259. Ills. Price, $1.50, 4/6. London: The Technical Publishing Company; New York: D. Van Nostrand Company.

A second edition of a work first published in 1902. The information given is intended for users of pumping machinery rather than for makers. The leading types of pumps are considered in detail and their construction and capabilities described with a view to enabling the buyer to choose the type best suited to his own particular requirements. In the second edition the material has been brought up to date by the addition of new illustrations and particularly by the addition of several chapters on the high lift turbine pump.

Rand.

The Commercial Aspect of Rand "Profits." By George A. Denny. Size, 10¼ by 5½ in.; pp., 40. Price, 1/. London: The Mining Journal.

A reprint of a series of articles which appeared originally in *The Mining Journal*, where they attracted a great deal of attention both in England and abroad. The situation on the Rand is a subject of absorbing interest both technically and economically. The mining interests in the field recognize the imminent danger of the exhaustion of the high-grade ore deposits and every possible means of reducing working costs is being taken in the effort to save the industry. Mr. Denny's well-informed review shows that a radical change in methods of management is necessary before the gold-mining industry can be placed on a firm foundation and that given rational financial methods, the exhaustion of the high-grade deposits becomes a phenomenon of secondary importance so far as the position of the Rand as the greatest gold field of the world is concerned.

Steam Plant Chemistry.

Engine-Room Chemistry, a Compend for the Engineer and Engineman. By Augustus H. Gill. Size, 7 by 4½ in.; pp., 200. Ills. Price, $1. New York and London: Hill Publishing Company.

This is a very useful little book for the engineer in charge of steam plants as it gives in clear and concise form the chemical information necessary for the intelligent testing and analysis of boiler fuels and waters, flue gases and lubricants. Such tests are being more and more recognized as an essential factor in the economical management of boilers and engines and the clearness and thoroughness with which this handbook is written should give it a wide usefulness. It gives in simple language only the essential principles of chemistry necessary for the understanding of the practical directions for conducting tests, to which the greater part of the book is devoted. By the aid of the latter the engineer can determine the lubricants best suited to his purpose; he can make his own analysis of the flue gases; he will know the quality of the fuel he buys and the qualities of the feed water and how to neutralize the scale forming propensities of the latter. The subject of the regulation of combustion is also covered in a thorough and interesting manner.

Steam Traps.

Modern Steam Traps (English and American): their Construction and Working. By Gordon Stewart. Size, 7 by 5 in.; pp., viii, 104. Ills. Price, 3/, $1.25. London: The Technical Publishing Co., Limited; New York: D. Van Nostrand Co.

A reprint of a series of articles which appeared originally in *The Practical Engineer.* The book illustrates and describes all the leading types of steam traps and while it does not pretend to deal exhaustively with the subject, it places before the user in an interesting and practical manner a large amount of information concerning the points most vital to the proper and efficient working of such apparatus.

Strength of Materials.

Problems in Strength of Materials. By William Kent Shepard. Size, 9½ by 6 in.; pp., 70. Diagrams. Price, $1.30. New York and London: Ginn and Company.

A very useful little book, intended to supplement text-books on the theory of structures and strength of materials which usually lack a sufficient number of practical examples fully to impress upon the mind of the student the applications of the theory. The book contains a collection of over five hundred graded practical problems on Tension, Compression and Shear; Elastic Deformation; Thin Cylinders and Spheres; Riveted Joints; Cantilever and Simple Beams; Overhanging, Fixed and Continuous Beams; Columns and Struts; Torsion; Combined Stresses; Compound Columns and Beams; Thick Cylinders and Guns; and Flat Plates. Tables necessary for the solution of the problems are given in the appendix. The use of this book will greatly lessen the labor of class-room teaching.

Water Power.

How to Use Water Power. By Herbert Chatley. Size, 7 by 5 in.; pp., 92. Price, $1. London: The Technical Publishing Co., Limited; New York: D. Van Nostrand Co.

The author has not attempted to produce an exhaustive treatise but a clear account of the methods and principles of hydraulic principles as at present practiced in a form that can be easily grasped by the craftsman or student with limited knowledge of mechanics and mathematics. Among the subjects treated are: the sources and transmission of power, the hydraulic press, water wheels, turbines, pumps, hydraulic engines, tidal power, and water supply problems.

Water Supply.

Clean Water and How to Get it. By Allen Hazen. Size, 8 by 5½ in.; pp., vi, 178. Ills, 14. Price, $1.50, 6/6. New York: John Wiley & Sons; London: Chapman & Hall, Limited.

This little volume deals with the means adopted in the best American practice to secure clean water for cities, and with the applications of these means to new problems. It is not intended to serve as an exhaustive treatise on water-supply problems, but merely to help beginners to understand something of first principles. The author fully attains his purpose to present a clear and concise discussion of the broad general principles of water-supply engineering and the seeker after this sort of information will find the work invaluable. Illustrations are freely used and typical plants are described wherever the application of principles to practice can be best shown by concrete examples. Besides the purely technical information the book contains a great deal to interest those connected with the administration of water-supply systems. Matters of general policy, the sale of water, the financial management of water works, etc., are considered in broad outline. Taken as a whole the book should prove of great value to city officials who are charged with the responsibility for procuring pure water and who have no previous technical or financial knowledge of water-supply engineering.

Wood Distillation.

The Utilisation of Wood Waste by Distillation. By Walter B. Harper. Size, 12 by 9 in.; pp., 156. Ills., 74. Price, $3. St. Louis, Mo.: Journal of Commerce Company.

A general consideration of the industry of wood distilling, including a description of the apparatus used and the principles involved, also methods of chemical control and disposal of the products. The material contained in the book was first published in a series of articles in *The Lumberman* which were among the most valuable contributions to the literature of the problem of extracting chemical products from the waste wood of saw mills. The book emphasizes the growing importance of the utilization of waste products, gives a complete discussion of the products which may be derived from pine wood by distillation, describes the various methods and processes used, and gives many hints as to the technical and economic management of plants for this purpose. It should prove of value to those connected with the industries in which turpentine, resin, tar, alcohol, etc., play an important part as well as to the lumberman and paper maker in whose interests the book is primarily written.

BOOKS RECEIVED.

Water Supply. By Frederick E. Turneaure. Size, 9½ by 6½ in.; pp., 143. Ills. Price, $1. Chicago, Ill.: American School of Correspondence.

Mechanical Drawing. By Ervin Kenison. Size, 9½ by 6½ in.; pp., 142. Ills. Price, $1. Chicago: The American School of Correspondence.

Plane Surveying. By Alfred E. Phillips. Size, 9½ by 6½ in.; pp., 207. Ills. Price, $1.50. Chicago, Ill.: American School of Correspondence.

Report of the Chief of the Weather Bureau for 1907. By Willis L. Moore. Size, 9 by 6 in.; pp., 56. Ills. Washington: Department of Agriculture.

Proceedings of the Master Car Builders' Association, Vol. 41, 1907. Size, 9 by 6 in.; pp., 642. Ills. Plates. Chicago, Ill.: Published by the Association.

The "Mechanical World" Pocket Diary and Year Book for 1908. Size, 6¼ by 4 in.; pp., 392. Ills. Price, 6d. Manchester: Smmott & Company, Limited.

Machine Shop Work. By Frederick W. Turner. Size, 9½ by 6½ in.; pp., 190. Ills. Price, $1.50. Chicago: The American School of Correspondence.

Annual Report of the Smithsonian Institution, 1906. Size, 9 by 6 in.; pp., li, 546. Ills. Maps. Washington, D. C.: Published by the Smithsonian Institution.

The Steam Engine. By Walter B. Snow and Walter S. Leland. Size, 9½ by 6½ in.; pp., 156. Ills. Price, $1. Chicago: The American School of Correspondence.

Valve Gears and Indicators. By Walter S. Leland and Carl S. Dow. Size, 9½ by 6½ in.; pp., 111. Ills. Price, $1. Chicago: The American School of Correspondence.

Highway Construction. By Austin T. Byrne and Alfred E. Phillips. Size, 9½ by 6½ in.; pp., 136. Ills. Price, $1. Chicago, Ill.: American School of Correspondence.

State of Ohio, Highway Department; Bulletin No. 9: Proposed Amended State Aid Law. By Sam Huston. Size, 9½ by 6½ in.; pp., 67. Columbus, O.: State Highway Department.

Report of the Proceedings of the Fortieth Annual Convention of the American Railway Master Mechanics' Association. Size, 9 by 6 in.; pp., 453. Ills. Chicago, Ill.: Published by the Association.

Annual Report of the Minister of Mines of British Columbia for the Year Ending December 31, 1906. Size, 10 by 7 in.; pp., 276. Ills. Maps. Victoria, B. C.: Department of Mines of British Columbia.

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